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**Title 40 —Protection of Environment**  
**Chapter I —Environmental Protection Agency**  
**Subchapter C —Air Programs**

**Part 98** Mandatory Greenhouse Gas Reporting

**Subpart A** General Provision

- § 98.1 Purpose and scope.
- § 98.2 Who must report?
- § 98.3 What are the general monitoring, reporting, recordkeeping and verification requirements of this part?
- § 98.4 Authorization and responsibilities of the designated representative.
- § 98.5 How is the report submitted?
- § 98.6 Definitions.
- § 98.7 What standardized methods are incorporated by reference into this part?
- § 98.8 What are the compliance and enforcement provisions of this part?
- § 98.9 Addresses.

**Table A-1 to Subpart A of Part 98**

Global Warming Potentials, 100-Year Time Horizon

**Table A-2 to Subpart A of Part 98**

Units of Measure Conversions

**Table A-3 to Subpart A of Part 98**

Source Category List for § 98.2(a)(1)

**Table A-4 to Subpart A of Part 98**

Source Category List for § 98.2(a)(2)

**Table A-5 to Subpart A of Part 98**

Supplier Category List for § 98.2(a)(4)

**Table A-6 to Subpart A of Part 98**

Data Elements That Are Inputs to Emission Equations and for  
Which the Reporting Deadline Is March 31, 2013

**Table A-7 to Subpart A of Part 98**

Data Elements That Are Inputs to Emission Equations and for  
Which the Reporting Deadline Is March 31, 2015

*Subpart B [Reserved]*

**Subpart C** General Stationary Fuel Combustion Sources

- § 98.30 Definition of the source category.
- § 98.31 Reporting threshold.

- § 98.32 GHGs to report.
- § 98.33 Calculating GHG emissions.
- § 98.34 Monitoring and QA/QC requirements.
- § 98.35 Procedures for estimating missing data.
- § 98.36 Data reporting requirements.
- § 98.37 Records that must be retained.
- § 98.38 Definitions.

**Table C-1 to Subpart C of Part 98**

Default CO<sub>2</sub> Emission Factors and High Heat Values for  
Various Types of Fuel

**Table C-2 to Subpart C of Part 98**

Default CH<sub>4</sub> and N<sub>2</sub>O Emission Factors for Various Types of  
Fuel

**Subpart D** Electricity Generation

- § 98.40 Definition of the source category.
- § 98.41 Reporting threshold.
- § 98.42 GHGs to report.
- § 98.43 Calculating GHG emissions.
- § 98.44 Monitoring and QA/QC requirements.
- § 98.45 Procedures for estimating missing data.
- § 98.46 Data reporting requirements.
- § 98.47 Records that must be retained.
- § 98.48 Definitions.

**Subpart E** Adipic Acid Production

- § 98.50 Definition of source category.
- § 98.51 Reporting threshold.
- § 98.52 GHGs to report.
- § 98.53 Calculating GHG emissions.
- § 98.54 Monitoring and QA/QC requirements.
- § 98.55 Procedures for estimating missing data.
- § 98.56 Data reporting requirements.
- § 98.57 Records that must be retained.
- § 98.58 Definitions.

**Subpart F** Aluminum Production

- § 98.60 Definition of the source category.
- § 98.61 Reporting threshold.
- § 98.62 GHGs to report.
- § 98.63 Calculating GHG emissions.
- § 98.64 Monitoring and QA/QC requirements.

- § 98.65 Procedures for estimating missing data.
- § 98.66 Data reporting requirements.
- § 98.67 Records that must be retained.
- § 98.68 Definitions.

**Table F-1 to Subpart F of Part 98**

Slope and Overvoltage Coefficients for the Calculation of PFC  
Emissions From Aluminum Production

**Table F-2 to Subpart F of Part 98**

Default Data Sources for Parameters Used for CO<sub>2</sub> Emissions

**Subpart G** Ammonia Manufacturing

- § 98.70 Definition of source category.
- § 98.71 Reporting threshold.
- § 98.72 GHGs to report.
- § 98.73 Calculating GHG emissions.
- § 98.74 Monitoring and QA/QC requirements.
- § 98.75 Procedures for estimating missing data.
- § 98.76 Data reporting requirements.
- § 98.77 Records that must be retained.
- § 98.78 Definitions.

**Subpart H** Cement Production

- § 98.80 Definition of the source category.
- § 98.81 Reporting threshold.
- § 98.82 GHGs to report.
- § 98.83 Calculating GHG emissions.
- § 98.84 Monitoring and QA/QC requirements.
- § 98.85 Procedures for estimating missing data.
- § 98.86 Data reporting requirements.
- § 98.87 Records that must be retained.
- § 98.88 Definitions.

**Subpart I** Electronics Manufacturing

- § 98.90 Definition of the source category.
- § 98.91 Reporting threshold.
- § 98.92 GHGs to report.
- § 98.93 Calculating GHG emissions.
- § 98.94 Monitoring and QA/QC requirements.
- § 98.95 Procedures for estimating missing data.
- § 98.96 Data reporting requirements.
- § 98.97 Records that must be retained.
- § 98.98 Definitions.

**Table I-1 to Subpart I of Part 98**

Default Emission Factors for Manufacturing Capacity-Based  
Threshold Applicability Determination

**Table I-2 to Subpart I of Part 98**

Default Emission Factors for Gas Consumption-Based  
Threshold Applicability Determination

**Table I-3 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor  
Manufacturing for 150 mm and 200 mm Wafer Sizes

**Table I-4 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor  
Manufacturing for 300 mm and 450 mm Wafer Size

**Table I-5 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for MEMS  
Manufacturing

**Table I-6 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for LCD Manufacturing

**Table I-7 To Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for PV Manufacturing

**Table I-8 to Subpart I of Part 98**

Default Emission Factors ( $1-UN_2O_j$ ) for  $N_2O$  Utilization ( $UN_2O_j$ )

**Table I-9 to Subpart I of Part 98**

Methods and Procedures for Conducting Emissions Test for  
Stack Systems

**Table I-10 to Subpart I of Part 98**

Maximum Field Detection Limits Applicable to Fluorinated GHG  
Concentration Measurements for Stack Systems

**Table I-11 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor  
Manufacturing for Use With the Stack Test Method

**Table I-12 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor  
Manufacturing for Use With the Stack Test Method

**Table I-13 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for LCD Manufacturing  
for Use With the Stack Test Method

**Table I-14 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for PV Manufacturing for  
Use With the Stack Test Method

**Table I-15 to Subpart I of Part 98**

Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for MEMS Manufacturing  
for Use With the Stack Test Method

**Table I-16 to Subpart I of Part 98**

Default Emission Destruction or Removal Efficiency (DRE)  
Factors for Electronics Manufacturing

**Table I-17 to Subpart I of Part 98**

Expected and Possible By-Products for Electronics  
Manufacturing

**Table I-18 to Subpart I of Part 98**

Default Factors for Gamma ( $g_{i,p}$  and  $g_{k,i,p}$ ) for Semiconductor  
Manufacturing and for MEMS and PV Manufacturing Under  
Certain Conditions \* for Use With the Stack Testing Method

**Table I-19 to Subpart I of Part 98**

Reference Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates  
( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor  
Manufacturing for 150 mm and 200 mm Wafer Sizes

**Table I-20 to Subpart I of Part 98**

Reference Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates  
( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor  
Manufacturing for 300 mm Wafer Sizes

**Table I-21 to Subpart I of Part 98**

Examples of Fluorinated GHGs Used by the Electronics  
Industry

**Appendix A to Subpart I of Part 98**

Alternative Procedures for Measuring Point-of-Use Abatement  
Device Destruction or Removal Efficiency

*Subpart J [Reserved]*

**Subpart K**      Ferroalloy Production

- § 98.110 Definition of the source category.
- § 98.111 Reporting threshold.
- § 98.112 GHGs to report.
- § 98.113 Calculating GHG emissions.
- § 98.114 Monitoring and QA/QC requirements.
- § 98.115 Procedures for estimating missing data.
- § 98.116 Data reporting requirements.
- § 98.117 Records that must be retained.
- § 98.118 Definitions.

**Table K-1 to Subpart K of Part 98**

Electric Arc Furnace (EAF) CH<sub>4</sub> Emission Factors

**Subpart L**      Fluorinated Gas Production

- § 98.120 Definition of the source category.
- § 98.121 Reporting threshold.
- § 98.122 GHGs to report.
- § 98.123 Calculating GHG emissions.
- § 98.124 Monitoring and QA/QC requirements.
- § 98.125 Procedures for estimating missing data.
- § 98.126 Data reporting requirements.
- § 98.127 Records that must be retained.
- § 98.128 Definitions.

**Table L-1 to Subpart L of Part 98**

Ranges of Effective Destruction Efficiency

**Appendix A to Subpart L of Part 98**

Mass Balance Method for Fluorinated Gas Production

*Subpart M [Reserved]*

**Subpart N**      Glass Production

- § 98.140 Definition of the source category.
- § 98.141 Reporting threshold.
- § 98.142 GHGs to report.
- § 98.143 Calculating GHG emissions.
- § 98.144 Monitoring and QA/QC requirements.
- § 98.145 Procedures for estimating missing data.
- § 98.146 Data reporting requirements.

§ 98.147 Records that must be retained.

§ 98.148 Definitions.

**Table N-1 to Subpart N of Part 98**

CO<sub>2</sub> Emission Factors for Carbonate-Based Raw Materials

**Subpart O** HCFC-22 Production and HFC-23 Destruction

§ 98.150 Definition of the source category.

§ 98.151 Reporting threshold.

§ 98.152 GHGs to report.

§ 98.153 Calculating GHG emissions.

§ 98.154 Monitoring and QA/QC requirements.

§ 98.155 Procedures for estimating missing data.

§ 98.156 Data reporting requirements.

§ 98.157 Records that must be retained.

§ 98.158 Definitions.

**Table O-1 to Subpart O of Part 98**

Emission Factors for Equipment Leaks

**Subpart P** Hydrogen Production

§ 98.160 Definition of the source category.

§ 98.161 Reporting threshold.

§ 98.162 GHGs to report.

§ 98.163 Calculating GHG emissions.

§ 98.164 Monitoring and QA/QC requirements.

§ 98.165 Procedures for estimating missing data.

§ 98.166 Data reporting requirements.

§ 98.167 Records that must be retained.

§ 98.168 Definitions.

**Subpart Q** Iron and Steel Production

§ 98.170 Definition of the source category.

§ 98.171 Reporting threshold.

§ 98.172 GHGs to report.

§ 98.173 Calculating GHG emissions.

§ 98.174 Monitoring and QA/QC requirements.

§ 98.175 Procedures for estimating missing data.

§ 98.176 Data reporting requirements.

§ 98.177 Records that must be retained.

§ 98.178 Definitions.

**Subpart R** Lead Production

§ 98.180 Definition of the source category.

§ 98.181 Reporting threshold.

- § 98.182 GHGs to report.
- § 98.183 Calculating GHG emissions.
- § 98.184 Monitoring and QA/QC requirements.
- § 98.185 Procedures for estimating missing data.
- § 98.186 Data reporting procedures.
- § 98.187 Records that must be retained.
- § 98.188 Definitions.

**Subpart S**      Lime Manufacturing

- § 98.190 Definition of the source category.
- § 98.191 Reporting threshold.
- § 98.192 GHGs to report.
- § 98.193 Calculating GHG emissions.
- § 98.194 Monitoring and QA/QC requirements.
- § 98.195 Procedures for estimating missing data.
- § 98.196 Data reporting requirements.
- § 98.197 Records that must be retained.
- § 98.198 Definitions.

**Table S-1 to Subpart S of Part 98**

Basic Parameters for the Calculation of Emission Factors for  
Lime Production

**Subpart T**      Magnesium Production

- § 98.200 Definition of source category.
- § 98.201 Reporting threshold.
- § 98.202 GHGs to report.
- § 98.203 Calculating GHG emissions.
- § 98.204 Monitoring and QA/QC requirements.
- § 98.205 Procedures for estimating missing data.
- § 98.206 Data reporting requirements.
- § 98.207 Records that must be retained.
- § 98.208 Definitions.

**Subpart U**      Miscellaneous Uses of Carbonate

- § 98.210 Definition of the source category.
- § 98.211 Reporting threshold.
- § 98.212 GHGs to report.
- § 98.213 Calculating GHG emissions.
- § 98.214 Monitoring and QA/QC requirements.
- § 98.215 Procedures for estimating missing data.
- § 98.216 Data reporting requirements.
- § 98.217 Records that must be retained.



§ 98.218 Definitions.

**Table U-1 to Subpart U of Part 98**

CO<sub>2</sub> Emission Factors for Common Carbonates

**Subpart V** Nitric Acid Production

§ 98.220 Definition of source category.

§ 98.221 Reporting threshold.

§ 98.222 GHGs to report.

§ 98.223 Calculating GHG emissions.

§ 98.224 Monitoring and QA/QC requirements.

§ 98.225 Procedures for estimating missing data.

§ 98.226 Data reporting requirements.

§ 98.227 Records that must be retained.

§ 98.228 Definitions.

**Subpart W** Petroleum and Natural Gas Systems

§ 98.230 Definition of the source category.

§ 98.231 Reporting threshold.

§ 98.232 GHGs to report.

§ 98.233 Calculating GHG emissions.

§ 98.234 Monitoring and QA/QC requirements.

§ 98.235 Procedures for estimating missing data.

§ 98.236 Data reporting requirements.

§ 98.237 Records that must be retained.

§ 98.238 Definitions.

**Table W-1 to Subpart W of Part 98**

Default Whole Gas Population Emission Factors

**Table W-2 to Subpart W of Part 98**

Default Whole Gas Leaker Emission Factors

**Table W-3 to Subpart W of Part 98**

Default Total Hydrocarbon Population Emission Factors

**Table W-4 to Subpart W of Part 98**

Default Total Hydrocarbon Leaker Emission Factors

**Table W-5 to Subpart W of Part 98**

Default Methane Population Emission Factors

**Table W-6 to Subpart W of Part 98**

Default Methane Leaker Emission Factors

**Table W-7 to Subpart W of Part 98**

Default Methane Emission Factors for Internal Combustion

Equipment

**Subpart X**      Petrochemical Production

- § 98.240 Definition of the source category.
- § 98.241 Reporting threshold.
- § 98.242 GHGs to report.
- § 98.243 Calculating GHG emissions.
- § 98.244 Monitoring and QA/QC requirements.
- § 98.245 Procedures for estimating missing data.
- § 98.246 Data reporting requirements.
- § 98.247 Records that must be retained.
- § 98.248 Definitions.

**Subpart Y**      Petroleum Refineries

- § 98.250 Definition of source category.
- § 98.251 Reporting threshold.
- § 98.252 GHGs to report.
- § 98.253 Calculating GHG emissions.
- § 98.254 Monitoring and QA/QC requirements.
- § 98.255 Procedures for estimating missing data.
- § 98.256 Data reporting requirements.
- § 98.257 Records that must be retained.
- § 98.258 Definitions.

**Subpart Z**      Phosphoric Acid Production

- § 98.260 Definition of the source category.
- § 98.261 Reporting threshold.
- § 98.262 GHGs to report.
- § 98.263 Calculating GHG emissions.
- § 98.264 Monitoring and QA/QC requirements.
- § 98.265 Procedures for estimating missing data.
- § 98.266 Data reporting requirements.
- § 98.267 Records that must be retained.
- § 98.268 Definitions.

**Table Z-1 to Subpart Z of Part 98**

Default Chemical Composition of Phosphate Rock by Origin

**Subpart AA**      Pulp and Paper Manufacturing

- § 98.270 Definition of source category.
- § 98.271 Reporting threshold.
- § 98.272 GHGs to report.
- § 98.273 Calculating GHG emissions.
- § 98.274 Monitoring and QA/QC requirements.

§ 98.275 Procedures for estimating missing data.

§ 98.276 Data reporting requirements.

§ 98.277 Records that must be retained.

§ 98.278 Definitions.

**Table AA-1 to Subpart AA of Part 98**

Kraft Pulping Liquor Emissions Factors for Biomass-Based  
CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O

**Table AA-2 to Subpart AA of Part 98**

Kraft Lime Kiln and Calciner Emissions Factors for CH<sub>4</sub> and  
N<sub>2</sub>O

**Subpart BB** Silicon Carbide Production

§ 98.280 Definition of the source category.

§ 98.281 Reporting threshold.

§ 98.282 GHGs to report.

§ 98.283 Calculating GHG emissions.

§ 98.284 Monitoring and QA/QC requirements.

§ 98.285 Procedures for estimating missing data.

§ 98.286 Data reporting requirements.

§ 98.287 Records that must be retained.

§ 98.288 Definitions.

**Subpart CC** Soda Ash Manufacturing

§ 98.290 Definition of the source category.

§ 98.291 Reporting threshold.

§ 98.292 GHGs to report.

§ 98.293 Calculating GHG emissions.

§ 98.294 Monitoring and QA/QC requirements.

§ 98.295 Procedures for estimating missing data.

§ 98.296 Data reporting requirements.

§ 98.297 Records that must be retained.

§ 98.298 Definitions.

**Subpart DD** Electrical Transmission and Distribution Equipment Use

§ 98.300 Definition of the source category.

§ 98.301 Reporting threshold.

§ 98.302 GHGs to report.

§ 98.303 Calculating GHG emissions.

§ 98.304 Monitoring and QA/QC requirements.

§ 98.305 Procedures for estimating missing data.

§ 98.306 Data reporting requirements.

§ 98.307 Records that must be retained.

**§ 98.308** Definitions.

**Subpart EE** Titanium Dioxide Production

**§ 98.310** Definition of the source category.

**§ 98.311** Reporting threshold.

**§ 98.312** GHGs to report.

**§ 98.313** Calculating GHG emissions.

**§ 98.314** Monitoring and QA/QC requirements.

**§ 98.315** Procedures for estimating missing data.

**§ 98.316** Data reporting requirements.

**§ 98.317** Records that must be retained.

**§ 98.318** Definitions.

**Subpart FF** Underground Coal Mines

**§ 98.320** Definition of the source category.

**§ 98.321** Reporting threshold.

**§ 98.322** GHGs to report.

**§ 98.323** Calculating GHG emissions.

**§ 98.324** Monitoring and QA/QC requirements.

**§ 98.325** Procedures for estimating missing data.

**§ 98.326** Data reporting requirements.

**§ 98.327** Records that must be retained.

**§ 98.328** Definitions.

**Subpart GG** Zinc Production

**§ 98.330** Definition of the source category.

**§ 98.331** Reporting threshold.

**§ 98.332** GHGs to report.

**§ 98.333** Calculating GHG emissions.

**§ 98.334** Monitoring and QA/QC requirements.

**§ 98.335** Procedures for estimating missing data.

**§ 98.336** Data reporting requirements.

**§ 98.337** Records that must be retained.

**§ 98.338** Definitions.

**Subpart HH** Municipal Solid Waste Landfills

**§ 98.340** Definition of the source category.

**§ 98.341** Reporting threshold.

**§ 98.342** GHGs to report.

**§ 98.343** Calculating GHG emissions.

**§ 98.344** Monitoring and QA/QC requirements.

**§ 98.345** Procedures for estimating missing data.

**§ 98.346** Data reporting requirements.

§ 98.347 Records that must be retained.

§ 98.348 Definitions.

**Table HH-1 to Subpart HH of Part 98**

Emissions Factors, Oxidation Factors and Methods

**Table HH-2 to Subpart HH of Part 98**

U.S. Per Capita Waste Disposal Rates

**Table HH-3 to Subpart HH of Part 98**

Landfill Gas Collection Efficiencies

**Table HH-4 to Subpart HH of Part 98**

Landfill Methane Oxidation Fractions

**Subpart II Industrial Wastewater Treatment**

§ 98.350 Definition of source category.

§ 98.351 Reporting threshold.

§ 98.352 GHGs to report.

§ 98.353 Calculating GHG emissions.

§ 98.354 Monitoring and QA/QC requirements.

§ 98.355 Procedures for estimating missing data.

§ 98.356 Data reporting requirements.

§ 98.357 Records that must be retained.

§ 98.358 Definitions.

**Table II-1 to Subpart II of Part 98**

Emission Factors

**Table II-2 to Subpart II of Part 98**

Collection Efficiencies of Anaerobic Processes

**Subpart JJ Manure Management**

§ 98.360 Definition of the source category.

§ 98.361 Reporting threshold.

§ 98.362 GHGs to report.

§ 98.363 Calculating GHG emissions.

§ 98.364 Monitoring and QA/QC requirements.

§ 98.365 Procedures for estimating missing data.

§ 98.366 Data reporting requirements.

§ 98.367 Records that must be retained.

§ 98.368 Definitions.

**Table JJ-1 to Subpart JJ of Part 98**

Animal Population Threshold Level Below Which Facilities Are  
Not Required To Report Emissions Under Subpart JJ <sup>1 2</sup>

**Table JJ-2 to Subpart JJ of Part 98**

Waste Characteristics Data

**Table JJ-3 to Subpart JJ of Part 98**

State-Specific Volatile Solids (VS) and Nitrogen (N) Excretion  
Rates for Cattle

**Table JJ-4 to Subpart JJ of Part 98**

Volatile Solids and Nitrogen Removal through Solids  
Separation

**Table JJ-6 to Subpart JJ of Part 98**

Collection Efficiencies of Anaerobic Digesters

**Table JJ-7 to Subpart JJ of Part 98**

Nitrous Oxide Emission Factors (kg N<sub>2</sub>O-N/kg Kjdl N)

*Subpart KK [Reserved]*

**Subpart LL** Suppliers of Coal-based Liquid Fuels

- § 98.380 Definition of the source category.
- § 98.381 Reporting threshold.
- § 98.382 GHGs to report.
- § 98.383 Calculating GHG emissions.
- § 98.384 Monitoring and QA/QC requirements.
- § 98.385 Procedures for estimating missing data.
- § 98.386 Data reporting requirements.
- § 98.387 Records that must be retained.
- § 98.388 Definitions.

**Subpart MM** Suppliers of Petroleum Products

- § 98.390 Definition of the source category.
- § 98.391 Reporting threshold.
- § 98.392 GHGs To report.
- § 98.393 Calculating GHG emissions.
- § 98.394 Monitoring and QA/QC requirements.
- § 98.395 Procedures for estimating missing data.
- § 98.396 Data reporting requirements.
- § 98.397 Records that must be retained.
- § 98.398 Definitions.

**Table MM-1 to Subpart MM of Part 98**

Default Factors for Petroleum Products and Natural Gas  
Liquids <sup>1 2</sup>

**Table MM-2 to Subpart MM of Part 98**

Default Factors for Biomass-Based Fuels and Biomass

**Subpart NN** Suppliers of Natural Gas and Natural Gas Liquids

- § 98.400 Definition of the source category.
- § 98.401 Reporting threshold.
- § 98.402 GHGs to report.
- § 98.403 Calculating GHG emissions.
- § 98.404 Monitoring and QA/QC requirements.
- § 98.405 Procedures for estimating missing data.
- § 98.406 Data reporting requirements.
- § 98.407 Records that must be retained.
- § 98.408 Definitions.

**Table NN-1 to Subpart NN of Part 98**

Default Factors for Calculation Methodology 1 of This Subpart

**Table NN-2 to Subpart NN of Part 98**

Default Factors for Calculation Methodology 2 of This Subpart

**Subpart OO** Suppliers of Industrial Greenhouse Gases

- § 98.410 Definition of the source category.
- § 98.411 Reporting threshold.
- § 98.412 GHGs to report.
- § 98.413 Calculating GHG emissions.
- § 98.414 Monitoring and QA/QC requirements.
- § 98.415 Procedures for estimating missing data.
- § 98.416 Data reporting requirements.
- § 98.417 Records that must be retained.
- § 98.418 Definitions.

**Subpart PP** Suppliers of Carbon Dioxide

- § 98.420 Definition of the source category.
- § 98.421 Reporting threshold.
- § 98.422 GHGs to report.
- § 98.423 Calculating CO<sub>2</sub> supply.
- § 98.424 Monitoring and QA/QC requirements.
- § 98.425 Procedures for estimating missing data.
- § 98.426 Data reporting requirements.
- § 98.427 Records that must be retained.
- § 98.428 Definitions.

**Subpart QQ** Importers and Exporters of Fluorinated Greenhouse Gases Contained in Pre-Charged Equipment or Closed-Cell Foams

- § 98.430 Definition of the source category.
- § 98.431 Reporting threshold.
- § 98.432 GHGs to report.
- § 98.433 Calculating GHG contained in pre-charged equipment or closed-cell foams.
- § 98.434 Monitoring and QA/QC requirements.
- § 98.435 Procedures for estimating missing data.
- § 98.436 Data reporting requirements.
- § 98.437 Records that must be retained.
- § 98.438 Definitions.

**Subpart RR** Geologic Sequestration of Carbon Dioxide

- § 98.440 Definition of the source category.
- § 98.441 Reporting threshold.
- § 98.442 GHGs to report.
- § 98.443 Calculating CO<sub>2</sub> geologic sequestration.
- § 98.444 Monitoring and QA/QC requirements.
- § 98.445 Procedures for estimating missing data.



- § 98.446 Data reporting requirements.
- § 98.447 Records that must be retained.
- § 98.448 Geologic sequestration monitoring, reporting, and verification (MRV) plan.
- § 98.449 Definitions.

**Subpart SS**    Electrical Equipment Manufacture or Refurbishment

- § 98.450 Definition of the source category.
- § 98.451 Reporting threshold.
- § 98.452 GHGs to report.
- § 98.453 Calculating GHG emissions.
- § 98.454 Monitoring and QA/QC requirements.
- § 98.455 Procedures for estimating missing data.
- § 98.456 Data reporting requirements.
- § 98.457 Records that must be retained.
- § 98.458 Definitions.

**Subpart TT**    Industrial Waste Landfills

- § 98.460 Definition of the source category.
- § 98.461 Reporting threshold.
- § 98.462 GHGs to report.
- § 98.463 Calculating GHG emissions.
- § 98.464 Monitoring and QA/QC requirements.
- § 98.465 Procedures for estimating missing data.
- § 98.466 Data reporting requirements.
- § 98.467 Records that must be retained.
- § 98.468 Definitions.

**Table TT-1 to Subpart TT of Part 98**

Default DOC and Decay Rate Values for Industrial Waste Landfills

**Subpart UU**    Injection of Carbon Dioxide

- § 98.470 Definition of the source category.
- § 98.471 Reporting threshold.
- § 98.472 GHGs to report.
- § 98.473 Calculating CO<sub>2</sub> received.
- § 98.474 Monitoring and QA/QC requirements.
- § 98.475 Procedures for estimating missing data.
- § 98.476 Data reporting requirements.
- § 98.477 Records that must be retained.
- § 98.478 Definitions.

**Subpart VV**    Geologic Sequestration of Carbon Dioxide With Enhanced Oil Recovery Using ISO 27916

- § 98.480 Definition of the source category.
- § 98.481 Reporting threshold.
- § 98.482 GHGs to report.
- § 98.483 Calculating CO<sub>2</sub> geologic sequestration.
- § 98.484 Monitoring and QA/QC requirements.
- § 98.485 Procedures for estimating missing data.
- § 98.486 Data reporting requirements.
- § 98.487 Records that must be retained.
- § 98.488 EOR Operations Management Plan.
- § 98.489 Definitions.

**Subpart WW** Coke Calciners

- § 98.490 Definition of the source category.
- § 98.491 Reporting threshold.
- § 98.492 GHGs to report.
- § 98.493 Calculating GHG emissions.
- § 98.494 Monitoring and QA/QC requirements.
- § 98.495 Procedures for estimating missing data.
- § 98.496 Data reporting requirements.
- § 98.497 Records that must be retained.
- § 98.498 Definitions.

**Subpart XX** Calcium Carbide Production

- § 98.500 Definition of the source category.
- § 98.501 Reporting threshold.
- § 98.502 GHGs to report.
- § 98.503 Calculating GHG emissions.
- § 98.504 Monitoring and QA/QC requirements.
- § 98.505 Procedures for estimating missing data.
- § 98.506 Data reporting requirements.
- § 98.507 Records that must be retained.
- § 98.508 Definitions.

**Subpart YY** Caprolactam, Glyoxal, and Glyoxylic Acid Production

- § 98.510 Definition of the source category.
- § 98.511 Reporting threshold.
- § 98.512 GHGs to report.
- § 98.513 Calculating GHG emissions.
- § 98.514 Monitoring and QA/QC requirements.
- § 98.515 Procedures for estimating missing data.
- § 98.516 Data reporting requirements.
- § 98.517 Records that must be retained.

§ 98.518 Definitions.

**Table 1 to Subpart YY of Part 98**

N<sub>2</sub>O Generation Factors

**Subpart ZZ** Ceramics Manufacturing

§ 98.520 Definition of the source category.

§ 98.521 Reporting threshold.

§ 98.522 GHGs to report.

§ 98.523 Calculating GHG emissions.

§ 98.524 Monitoring and QA/QC requirements.

§ 98.525 Procedures for estimating missing data.

§ 98.526 Data reporting requirements.

§ 98.527 Records that must be retained.

§ 98.528 Definitions.

**Table 1 to Subpart ZZ of Part 98**

CO<sub>2</sub> Emission Factors for Carbonate-Based Raw Materials

## PART 98—MANDATORY GREENHOUSE GAS REPORTING

**Authority:** 42 U.S.C. 7401-7671q.

**Source:** 74 FR 56374, Oct. 30, 2009, unless otherwise noted.

**Editorial Note:** At 90 FR 21227, May 19, 2025, as required by the Congressional Review Act and Public Law 119-2, the Environmental Protection Agency removed the amendments to §§ 98.3 and 98.4 made effective on Jan. 17, 2025, at 89 FR 91163, Nov. 18, 2024. As of May 19, 2025, §§ 98.3 and 98.4 reverted to the Jan. 16, 2025 version.

### Subpart A—General Provision

#### § 98.1 Purpose and scope.

- (a) This part establishes mandatory greenhouse gas (GHG) reporting requirements for owners and operators of certain facilities that directly emit GHG as well as for certain suppliers. For suppliers, the GHGs reported are the quantity that would be emitted from combustion or use of the products supplied.
- (b) Owners and operators of facilities and suppliers that are subject to this part must follow the requirements of this subpart and all applicable subparts of this part. If a conflict exists between a provision in subpart A and any other applicable subpart, the requirements of the applicable subpart shall take precedence.
- (c) For facilities required to report under onshore petroleum and natural gas production under subpart W of this part, the terms *Owner* and *Operator* used in this subpart have the same definition as *Onshore petroleum and natural gas production owner or operator*, as defined in § 98.238. For facilities required to report under onshore petroleum and natural gas gathering and boosting under subpart W of this part, the terms *Owner* and *Operator* used in this subpart have the same definition as *Gathering and boosting system*

owner or operator, as defined in § 98.238. For facilities required to report under onshore natural gas transmission pipeline under subpart W of this part, the terms *Owner* and *Operator* used in this subpart have the same definition as *Onshore natural gas transmission pipeline owner or operator*, as defined in § 98.238.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 39758, July 12, 2010; 76 FR 73898, Nov. 29, 2011; 76 FR 80573, Dec. 23, 2011; 89 FR 42218, May 14, 2024]

## § 98.2 Who must report?

- (a) The GHG reporting requirements and related monitoring, recordkeeping, and reporting requirements of this part apply to the owners and operators of any facility that is located in the United States or under or attached to the Outer Continental Shelf (as defined in 43 U.S.C. 1331) and that meets the requirements of either paragraph (a)(1), (a)(2), or (a)(3) of this section; and any supplier that meets the requirements of paragraph (a)(4) of this section:
  - (1) **A facility that contains any source category that is listed in Table A-3 of this subpart.** For these facilities, the annual GHG report must cover stationary fuel combustion sources (subpart C of this part), miscellaneous use of carbonates (subpart U of this part), and all applicable source categories listed in Tables A-3 and A-4 of this subpart.
  - (2) **A facility that contains any source category that is listed in Table A-4 of this subpart and that emits 25,000 metric tons CO<sub>2</sub>e or more per year in combined emissions from stationary fuel combustion units, miscellaneous uses of carbonate, and all applicable source categories that are listed in Table A-3 and Table A-4 of this subpart.** For these facilities, the annual GHG report must cover stationary fuel combustion sources (subpart C of this part), miscellaneous use of carbonates (subpart U of this part), and all applicable source categories listed in Table A-3 and Table A-4 of this subpart.
  - (3) **A facility that in any calendar year starting in 2010 meets all three of the conditions listed in this paragraph (a)(3).** For these facilities, the annual GHG report must cover emissions from stationary fuel combustion sources only.
    - (i) The facility does not meet the requirements of either paragraph (a)(1) or (a)(2) of this section.
    - (ii) The aggregate maximum rated heat input capacity of the stationary fuel combustion units at the facility is 30 mmBtu/hr or greater.
    - (iii) The facility emits 25,000 metric tons CO<sub>2</sub>e or more per year in combined emissions from all stationary fuel combustion sources.
  - (4) **A supplier that is listed in Table A-5 of this subpart.** For these suppliers, the annual GHG report must cover all applicable products for which calculation methodologies are provided in the subparts listed in Table A-5 of this subpart.
  - (5) Research and development activities are not considered to be part of any source category defined in this part.
- (b) To calculate GHG emissions for comparison to the 25,000 metric ton CO<sub>2</sub>e per year emission threshold in paragraph (a)(2) of this section, the owner or operator shall calculate annual CO<sub>2</sub>e emissions, as described in paragraphs (b)(1) through (b)(4) of this section.

- (1) Calculate the annual emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and each fluorinated GHG in metric tons from all applicable source categories listed in paragraph (a)(2) of this section. The GHG emissions shall be calculated using the calculation methodologies specified in each applicable subpart and available company records.
- (2) For each general stationary fuel combustion unit, calculate the annual CO<sub>2</sub> emissions in metric tons using any of the four calculation methodologies specified in § 98.33(a). Calculate the annual CH<sub>4</sub> and N<sub>2</sub>O emissions from the stationary fuel combustion sources in metric tons using the appropriate equation in § 98.33(c). Exclude carbon dioxide emissions from the combustion of biomass, but include emissions of CH<sub>4</sub> and N<sub>2</sub>O from biomass combustion.
- (3) For miscellaneous uses of carbonate, calculate the annual CO<sub>2</sub> emissions in metric tons using the procedures specified in subpart U of this part.
- (4) Sum the emissions estimates from paragraphs (b)(1), (b)(2), and (b)(3) of this section for each GHG and calculate metric tons of CO<sub>2</sub>e using Equation A-1 of this section.

$$CO_2e = \sum_{i=1}^n GHG_i \times GWP_i \quad (\text{Eq. A-1})$$

Where:

CO<sub>2</sub>e = Carbon dioxide equivalent, metric tons/year.

GHG<sub>i</sub> = Mass emissions of each greenhouse gas, metric tons/year.

GWP<sub>i</sub> = Global warming potential for each greenhouse gas from Table A-1 of this subpart.

n = The number of greenhouse gases emitted.

- (5) For purpose of determining if an emission threshold has been exceeded, include in the emissions calculation any CO<sub>2</sub> that is captured for transfer off site.
- (c) To calculate GHG emissions for comparison to the 25,000 metric ton CO<sub>2</sub>e/year emission threshold for stationary fuel combustion under paragraph (a)(3) of this section, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary fuel combustion unit by following the methods specified in paragraph (b)(2) of this section. Then, convert the emissions of each GHG to metric tons CO<sub>2</sub>e per year using Equation A-1 of this section, and sum the emissions for all units at the facility.
- (d) To calculate GHG quantities for comparison to the 25,000 metric ton CO<sub>2</sub> per year threshold for importers and exporters of coal-to-liquid products under paragraph (a)(4) of this section, calculate the mass in metric tons per year of CO<sub>2</sub> that would result from the complete combustion or oxidation of the quantity of coal-to-liquid products that are imported during the reporting year and, that are exported during the reporting year. Compare the imported quantities and the exported quantities separately to the 25,000 metric ton CO<sub>2</sub> per year threshold. Calculate the quantities using the methodology specified in subpart LL of this part.
- (e) To calculate GHG quantities for comparison to the 25,000 metric ton CO<sub>2</sub>e per year threshold for importers and exporters of petroleum products under paragraph (a)(4) of this section, calculate the mass in metric tons per year of CO<sub>2</sub> that would result from the complete combustion or oxidation of the

combined volume of petroleum products and natural gas liquids that are imported during the reporting year and that are exported during the reporting year. Compare the imported quantities and the exported quantities separately to the 25,000 metric ton CO<sub>2</sub> per year threshold. Calculate the quantities using the methodology specified in subpart MM of this part.

- (f) To calculate GHG quantities for comparison to the 25,000 metric ton CO<sub>2</sub>e per year threshold under paragraph (a)(4) of this section for importers and exporters of industrial greenhouse gases and for importers and exporters of CO<sub>2</sub>, the owner or operator shall calculate the mass in metric tons per year of CO<sub>2</sub>e imports and exports as described in paragraphs (f)(1) through (f)(3) of this section. Compare the imported quantities and the exported quantities separately to the 25,000 metric ton CO<sub>2</sub> per year threshold.
  - (1) Calculate the mass in metric tons per year of CO<sub>2</sub>, N<sub>2</sub>O, each fluorinated GHG, and each fluorinated heat transfer fluid that is imported and the mass in metric tons per year of CO<sub>2</sub>, N<sub>2</sub>O, each fluorinated GHG, and each fluorinated heat transfer fluid that is exported during the year.
  - (2) Convert the mass of each imported and each GHG exported from paragraph (f)(1) of this section to metric tons of CO<sub>2</sub>e using Equation A-1 of this section.
  - (3) Sum the total annual metric tons of CO<sub>2</sub>e in paragraph (f)(2) of this section for all imported GHGs. Sum the total annual metric tons of CO<sub>2</sub>e in paragraph (f)(2) of this section for all exported GHGs.
- (g) If a capacity or generation reporting threshold in paragraph (a)(1) of this section applies, the owner or operator shall review the appropriate records and perform any necessary calculations to determine whether the threshold has been exceeded.
- (h) An owner or operator of a facility or supplier that does not meet the applicability requirements of paragraph (a) of this section is not subject to this rule. Such owner or operator would become subject to the rule and reporting requirements, if a facility or supplier exceeds the applicability requirements of paragraph (a) of this section at a later time pursuant to § 98.3(b)(3). Thus, the owner or operator should reevaluate the applicability to this part (including the revising of any relevant emissions calculations or other calculations) whenever there is any change that could cause a facility or supplier to meet the applicability requirements of paragraph (a) of this section. Such changes include but are not limited to process modifications, increases in operating hours, increases in production, changes in fuel or raw material use, addition of equipment, and facility expansion.
- (i) Except as provided in this paragraph, once a facility or supplier is subject to the requirements of this part, the owner or operator must continue for each year thereafter to comply with all requirements of this part, including the requirement to submit annual GHG reports, even if the facility or supplier does not meet the applicability requirements in paragraph (a) of this section in a future year.
  - (1) If reported CO<sub>2</sub>e emissions, calculated in accordance with § 98.3(c)(4)(i), are less than 25,000 metric tons per year for five consecutive years, then the owner or operator may discontinue complying with this part provided that the owner or operator submits a notification to the Administrator that announces the cessation of reporting and explains the reasons for the reduction in emissions. The notification shall be submitted no later than March 31 of the year immediately following the fifth consecutive year of emissions less than 25,000 tons CO<sub>2</sub>e per year. The owner or operator must maintain the corresponding records required under § 98.3(g) for each of the five consecutive years prior to notification of discontinuation of reporting and retain such records for three years following the year that reporting was discontinued. The owner or operator must resume reporting if annual CO<sub>2</sub>e emissions, calculated in accordance with paragraph (b)(4) of this section, in any future calendar year increase to 25,000 metric tons per year or more.

- (2) If reported CO<sub>2</sub>e emissions, calculated in accordance with § 98.3(c)(4)(i), were less than 15,000 metric tons per year for three consecutive years, then the owner or operator may discontinue complying with this part provided that the owner or operator submits a notification to the Administrator that announces the cessation of reporting and explains the reasons for the reduction in emissions. The notification shall be submitted no later than March 31 of the year immediately following the third consecutive year of emissions less than 15,000 tons CO<sub>2</sub>e per year. The owner or operator must maintain the corresponding records required under § 98.3(g) for each of the three consecutive years and retain such records for three years prior to notification of discontinuation of reporting following the year that reporting was discontinued. The owner or operator must resume reporting if annual CO<sub>2</sub>e emissions, calculated in accordance with paragraph (b)(4) of this section, in any future calendar year increase to 25,000 metric tons per year or more.
- (3) If the operations of a facility or supplier are changed such that all applicable processes and operations subject to paragraphs (a)(1) through (4) of this section cease to operate, then the owner or operator may discontinue complying with this part for the reporting years following the year in which cessation of such operations occurs, provided that the owner or operator submits a notification to the Administrator that announces the cessation of reporting and certifies to the closure of all applicable processes and operations no later than March 31 of the year following such changes. If one or more processes or operations subject to paragraphs (a)(1) through (4) of this section at a facility or supplier cease to operate, but not all applicable processes or operations cease to operate, then the owner or operator is exempt from reporting for any such processes or operations in the reporting years following the reporting year in which cessation of the process or operation occurs, provided that the owner or operator submits a notification to the Administrator that announces the cessation of reporting for the process or operation no later than March 31 following the first reporting year in which the process or operation has ceased for an entire reporting year. Cessation of operations in the context of underground coal mines includes, but is not limited to, abandoning and sealing the facility. This paragraph (i)(3) does not apply to seasonal or other temporary cessation of operations. This paragraph (i)(3) does not apply to the municipal solid waste landfills source category (subpart HH of this part), or the industrial waste landfills source category (subpart TT of this part). This paragraph (i)(3) does not apply when there is a change in the owner or operator for facilities in industry segments with a unique definition of facility as defined in § 98.238 of the petroleum and natural gas systems source category (subpart W of this part), unless the changes result in permanent cessation of all applicable processes and operations. The owner or operator must resume reporting for any future calendar year during which any of the GHG-emitting processes or operations resume operation.
- (4) The provisions of paragraphs (i)(1) and (2) of this section apply to suppliers subject to subparts LL through QQ of this part by substituting the term “quantity of GHG supplied” for “emissions.” For suppliers, the provisions of paragraphs (i)(1) and (2) apply individually to each importer and exporter and individually to each petroleum refinery, fractionator of natural gas liquids, local natural gas distribution company, and producer of CO<sub>2</sub>, N<sub>2</sub>O, or fluorinated greenhouse gases (e.g., a supplier of industrial greenhouse gases might qualify to discontinue reporting as an exporter of industrial greenhouse gases but still be required to report as an importer; or a company might qualify to discontinue reporting as a supplier of industrial greenhouse gases under subpart OO of this part but still be required to report as a supplier of carbon dioxide under subpart PP of this part).
- (5) If the operations of a facility or supplier are changed such that a process or operation no longer meets the “Definition of Source Category” as specified in an applicable subpart, then the owner or operator may discontinue complying with any such subpart for the reporting years following the year

in which change occurs, provided that the owner or operator submits a notification to the Administrator that announces the cessation of reporting for the process or operation no later than March 31 following the first reporting year in which such changes persist for an entire reporting year. The owner or operator must resume complying with this part for the process or operation starting in any future calendar year during which the process or operation meets the "Definition of Source Category" as specified in an applicable subpart.

- (6) If an entire facility or supplier is merged into another facility or supplier that is already reporting GHG data under this part, then the owner or operator may discontinue complying with this part for the facility or supplier, provided that the owner or operator submits a notification to the Administrator that announces the discontinuation of reporting and the e-GGRT identification number of the reconstituted facility no later than March 31 of the year following such changes.
- (7) If a facility in an industry segment with a unique definition of facility as defined in § 98.238 of the petroleum and natural gas systems source category (subpart W of this part) undergoes the type of change in owner or operator specified in paragraph § 98.4(n)(4) of this subpart, then the prior owner or operator may discontinue complying with the reporting requirements of this part for the facility for the reporting years following the year in which the change in owner or operator occurred, provided that the prior owner or operator submits a notification to the Administrator that announces the discontinuation of reporting no later than March 31 of the year following such change.
- (j) Table A-2 of this subpart provides a conversion table for some of the common units of measure used in part 98.
- (k) To calculate GHG quantities for comparison to the 25,000 metric ton CO<sub>2</sub>e per year threshold under paragraph (a)(4) of this section for facilities that destroy fluorinated GHGs or fluorinated heat transfer fluids, the owner or operator shall calculate the mass in metric tons per year of CO<sub>2</sub>e destroyed as described in paragraphs (k)(1) through (3) of this section.
  - (1) Calculate the mass in metric tons per year of each fluorinated GHG or fluorinated heat transfer fluid that is destroyed during the year.
  - (2) Convert the mass of each destroyed fluorinated GHG or fluorinated heat transfer fluid from paragraph (k)(1) of this section to metric tons of CO<sub>2</sub>e using equation A-1 to this section.
  - (3) Sum the total annual metric tons of CO<sub>2</sub>e in paragraph (k)(2) of this section for all destroyed fluorinated GHGs and destroyed fluorinated heat transfer fluids.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 39758, July 12, 2010; 75 FR 57685, Sept. 22, 2010; 76 FR 73899, Nov. 29, 2011; 75 FR 74487, Nov. 30, 2010; 79 FR 73776, Dec. 11, 2014; 81 FR 89248, Dec. 9, 2016; 89 FR 31889, Apr. 25, 2024; 89 FR 42218, May 14, 2024]

### § 98.3 What are the general monitoring, reporting, recordkeeping and verification requirements of this part?

The owner or operator of a facility or supplier that is subject to the requirements of this part must submit GHG reports to the Administrator, as specified in this section.

- (a) **General.** Except as provided in paragraph (d) of this section, follow the procedures for emission calculation, monitoring, quality assurance, missing data, recordkeeping, and reporting that are specified in each relevant subpart of this part.



- (b) **Schedule.** The annual GHG report for reporting year 2010 must be submitted no later than September 30, 2011. The annual report for reporting years 2011 and beyond must be submitted no later than March 31 of each calendar year for GHG emissions in the previous calendar year, except as provided in paragraphs (b)(1), (5), and (6) of this section.
- (1) For reporting year 2011, facilities with one or more of the subparts listed in paragraphs (b)(1)(i) through (xi) of this section and suppliers listed in paragraph (b)(1)(xii) of this section are required to submit their annual GHG report no later than September 28, 2012. Facilities and suppliers that are submitting their second annual GHG report in 2012 and that are reporting on one or more subparts listed in paragraphs (b)(1)(i) through (xii) of this section must notify the EPA by March 31, 2012, that they are not required to submit their annual GHG report until September 28, 2012.
- (i) Electronics Manufacturing (subpart I).
  - (ii) Fluorinated Gas Production (subpart L).
  - (iii) Magnesium Production (subpart T).
  - (iv) Petroleum and Natural Gas Systems (subpart W).
  - (v) Use of Electric Transmission and Distribution Equipment (subpart DD).
  - (vi) Underground Coal Mines (subpart FF).
  - (vii) Industrial Wastewater Treatment (subpart II).
  - (viii) Geologic Sequestration of Carbon Dioxide (subpart RR).
  - (ix) Manufacture of Electric Transmission and Distribution (subpart SS).
  - (x) Industrial Waste Landfills (subpart TT).
  - (xi) Injection of Carbon Dioxide (subpart UU).
  - (xii) Imports and Exports of Equipment Pre-charged with Fluorinated GHGs or Containing Fluorinated GHGs in Closed-cell Foams (subpart QQ).
- (2) For a new facility or supplier that begins operation on or after January 1, 2010, and becomes subject to the rule in the year that it becomes operational, report emissions starting the first operating month and ending on December 31 of that year. Each subsequent annual report must cover emissions for the calendar year, beginning on January 1 and ending on December 31.
- (3) For any facility or supplier that becomes subject to this rule because of a physical or operational change that is made after January 1, 2010, report emissions for the first calendar year in which the change occurs, beginning with the first month of the change and ending on December 31 of that year. For a facility or supplier that becomes subject to this rule solely because of an increase in hours of operation or level of production, the first month of the change is the month in which the increased hours of operation or level of production, if maintained for the remainder of the year, would cause the facility or supplier to exceed the applicable threshold. Each subsequent annual report must cover emissions for the calendar year, beginning on January 1 and ending on December 31.
- (4) Unless otherwise stated, if the final day of any time period falls on a weekend or a Federal holiday, the time period shall be extended to the next business day.
- (5) The annual GHG report for reporting year 2024 must be submitted no later than May 30, 2025.

(6) The annual GHG report for reporting year 2025 must be submitted no later than October 30, 2026.

(c) **Content of the annual report.** Except as provided in paragraph (d) of this section, each annual GHG report shall contain the following information:

(1) Facility name or supplier name (as appropriate), and physical street address of the facility or supplier, including the city, State, and zip code. If the facility does not have a physical street address, then the facility must provide the latitude and longitude representing the geographic centroid or center point of facility operations in decimal degree format. This must be provided in a comma-delimited "latitude, longitude" coordinate pair reported in decimal degrees to at least four digits to the right of the decimal point.

(2) Year and months covered by the report.

(3) Date of submittal.

(4) For facilities, except as otherwise provided in paragraph (c)(12) of this section, report annual emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, each fluorinated GHG (as defined in § 98.6), and each fluorinated heat transfer fluid (as defined in § 98.98) as follows.

(i) Annual emissions (excluding biogenic CO<sub>2</sub>) aggregated for all GHG from all applicable source categories, expressed in metric tons of CO<sub>2</sub>e calculated using Equation A-1 of this subpart. For electronics manufacturing (as defined in § 98.90), starting in reporting year 2012 the CO<sub>2</sub>e calculation must include each fluorinated heat transfer fluid (as defined in § 98.98) whether or not it is also a fluorinated GHG.

(ii) Annual emissions of biogenic CO<sub>2</sub> aggregated for all applicable source categories, expressed in metric tons.

(iii) Annual emissions from each applicable source category, expressed in metric tons of each applicable GHG listed in paragraphs (c)(4)(iii)(A) through (F) of this section.

(A) Biogenic CO<sub>2</sub>.

(B) CO<sub>2</sub> (excluding biogenic CO<sub>2</sub>).

(C) CH<sub>4</sub>.

(D) N<sub>2</sub>O.

(E) Each fluorinated GHG (as defined in § 98.6), except fluorinated gas production facilities must comply with § 98.126(a) rather than this paragraph (c)(4)(iii)(E). If a fluorinated GHG does not have a chemical-specific GWP in Table A-1 of this subpart, identify and report the fluorinated GHG group of which that fluorinated GHG is a member.

(F) For electronics manufacturing (as defined in § 98.90), each fluorinated heat transfer fluid (as defined in § 98.98) that is not also a fluorinated GHG as specified under (c)(4)(iii)(E) of this section. If a fluorinated heat transfer fluid does not have a chemical-specific GWP in Table A-1 of this subpart, identify and report the fluorinated GHG group of which that fluorinated heat transfer fluid is a member.

(G) For each reported fluorinated GHG and fluorinated heat transfer fluid, report the following identifying information:

- (1) Chemical name. If the chemical is not listed in Table A-1 of this subpart, then use the method of naming organic chemical compounds as recommended by the International Union of Pure and Applied Chemistry (IUPAC).
- (2) The CAS registry number assigned by the Chemical Abstracts Registry Service. If a CAS registry number is not assigned or is not associated with a single fluorinated GHG or fluorinated heat transfer fluid, then report an identification number assigned by EPA's Substance Registry Services.
- (3) Linear chemical formula.
- (iv) Except as provided in paragraph (c)(4)(vii) of this section, emissions and other data for individual units, processes, activities, and operations as specified in the "Data reporting requirements" section of each applicable subpart of this part.
- (v) Indicate (yes or no) whether reported emissions include emissions from a cogeneration unit located at the facility.
- (vi) [Reserved]
- (vii) The owner or operator of a facility is not required to report the data elements specified in Table A-6 of this subpart for calendar years 2010 through 2011 until March 31, 2013. The owner or operator of a facility is not required to report the data elements specified in Table A-7 of this subpart for calendar years 2010 through 2013 until March 31, 2015 (as part of the annual report for reporting year 2014), except as otherwise specified in Table A-7 of this subpart.
- (viii) Applicable source categories means stationary fuel combustion sources (subpart C of this part), miscellaneous use of carbonates (subpart U of this part), and all of the source categories listed in Table A-3 and Table A-4 of this subpart present at the facility.
- (5) For suppliers, report annual quantities of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and each fluorinated GHG (as defined in § 98.6) that would be emitted from combustion or use of the products supplied, imported, and exported during the year. Calculate and report quantities at the following levels:
  - (i) Total quantity of GHG aggregated for all GHG from all applicable supply categories in Table A-5 of this subpart and expressed in metric tons of CO<sub>2</sub>e calculated using Equation A-1 of this subpart.
  - (ii) Quantity of each GHG from each applicable supply category in Table A-5 to this subpart, expressed in metric tons of each GHG. For each reported fluorinated GHG, report the following identifying information:
    - (A) Chemical name. If the chemical is not listed in Table A-1 of this subpart, then use the method of naming organic chemical compounds as recommended by the International Union of Pure and Applied Chemistry (IUPAC).
    - (B) The CAS registry number assigned by the Chemical Abstracts Registry Service. If a CAS registry number is not assigned or is not associated with a single fluorinated GHG, then report an identification number assigned by EPA's Substance Registry Services.
    - (C) Linear chemical formula.
  - (iii) Any other data specified in the "Data reporting requirements" section of each applicable subpart of this part.

- (6) A written explanation, as required under § 98.3(e), if you change emission calculation methodologies during the reporting period.
- (7) A brief description of each “best available monitoring method” used, the parameter measured using the method, and the time period during which the “best available monitoring method” was used, if applicable.
- (8) Each parameter for which a missing data procedure was used according to the procedures of an applicable subpart and the total number of hours in the year that a missing data procedure was used for each parameter. Parameters include not only reported data elements, but any data element required for monitoring and calculating emissions.
- (9) A signed and dated certification statement provided by the designated representative of the owner or operator, according to the requirements of § 98.4(e)(1).
- (10) NAICS code(s) that apply to the facility or supplier.
  - (i) **Primary NAICS code.** Report the NAICS code that most accurately describes the facility or supplier's primary product/activity/service. The primary product/activity/service is the principal source of revenue for the facility or supplier. A facility or supplier that has two distinct products/activities/services providing comparable revenue may report a second primary NAICS code.
  - (ii) **Additional NAICS code(s).** Report all additional NAICS codes that describe all product(s)/activity(s)/service(s) at the facility or supplier that are not related to the principal source of revenue.
- (11) Legal name(s) and physical address(es) of the highest-level United States parent company(s) of the owners (or operators) of the facility or supplier and the percentage of ownership interest for each listed parent company as of December 31 of the year for which data are being reported according to the following instructions:
  - (i) If the facility or supplier is entirely owned by a single United States company that is not owned by another company, provide that company's legal name and physical address as the United States parent company and report 100 percent ownership.
  - (ii) If the facility or supplier is entirely owned by a single United States company that is, itself, owned by another company (e.g., it is a division or subsidiary of a higher-level company), provide the legal name and physical address of the highest-level company in the ownership hierarchy as the United States parent company and report 100 percent ownership.
  - (iii) If the facility or supplier is owned by more than one United States company (e.g., company A owns 40 percent, company B owns 35 percent, and company C owns 25 percent), provide the legal names and physical addresses of all the highest-level companies with an ownership interest as the United States parent companies, and report the percent ownership of each company.
  - (iv) If the facility or supplier is owned by a joint venture or a cooperative, the joint venture or cooperative is its own United States parent company. Provide the legal name and physical address of the joint venture or cooperative as the United States parent company, and report 100 percent ownership by the joint venture or cooperative.

- (v) If the facility or supplier is entirely owned by a foreign company, provide the legal name and physical address of the foreign company's highest-level company based in the United States as the United States parent company, and report 100 percent ownership.
  - (vi) If the facility or supplier is partially owned by a foreign company and partially owned by one or more U.S. companies, provide the legal name and physical address of the foreign company's highest-level company based in the United States, along with the legal names and physical addresses of the other U.S. parent companies, and report the percent ownership of each of these companies.
  - (vii) If the facility or supplier is a federally owned facility, report "U.S. Government" and do not report physical address or percent ownership.
  - (viii) The facility or supplier must refer to the reporting instructions of the electronic GHG reporting tool regarding standardized conventions for the naming of a parent company.
- (12) For the 2010 reporting year only, facilities that have "part 75 units" (i.e. units that are subject to subpart D of this part or units that use the methods in part 75 of this chapter to quantify CO<sub>2</sub> mass emissions in accordance with § 98.33(a)(5)) must report annual GHG emissions either in full accordance with paragraphs (c)(4)(i) through (c)(4)(iii) of this section or in full accordance with paragraphs (c)(12)(i) through (c)(12)(iii) of this section. If the latter reporting option is chosen, you must report:
- (i) Annual emissions aggregated for all GHG from all applicable source categories, expressed in metric tons of CO<sub>2</sub>e calculated using Equation A-1 of this subpart. You must include biogenic CO<sub>2</sub> emissions from part 75 units in these annual emissions, but exclude biogenic CO<sub>2</sub> emissions from any non-part 75 units and other source categories.
  - (ii) Annual emissions of biogenic CO<sub>2</sub>, expressed in metric tons (excluding biogenic CO<sub>2</sub> emissions from part 75 units), aggregated for all applicable source categories.
  - (iii) Annual emissions from each applicable source category, expressed in metric tons of each applicable GHG listed in paragraphs (c)(12)(iii)(A) through (c)(12)(iii)(E) of this section.
    - (A) Biogenic CO<sub>2</sub> (excluding biogenic CO<sub>2</sub> emissions from part 75 units).
    - (B) CO<sub>2</sub>. You must include biogenic CO<sub>2</sub> emissions from part 75 units in these totals and exclude biogenic CO<sub>2</sub> emissions from other non-part 75 units and other source categories.
    - (C) CH<sub>4</sub>.
    - (D) N<sub>2</sub>O.
    - (E) Each fluorinated GHG (including those not listed in Table A-1 of this subpart).
- (13) An indication of whether the facility includes one or more plant sites that have been assigned a "plant code" (as defined under § 98.6) by either the Department of Energy's Energy Information Administration or by the EPA's Clean Air Markets Division.

(d) ***Special provisions for reporting year 2010.***

- (1) ***Best available monitoring methods.*** During January 1, 2010 through March 31, 2010, owners or operators may use best available monitoring methods for any parameter (e.g., fuel use, daily carbon content of feedstock by process line) that cannot reasonably be measured according to the monitoring and QA/QC requirements of a relevant subpart. The owner or operator must use the

calculation methodologies and equations in the “Calculating GHG Emissions” sections of each relevant subpart, but may use the best available monitoring method for any parameter for which it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by January 1, 2010. Starting no later than April 1, 2010, the owner or operator must discontinue using best available methods and begin following all applicable monitoring and QA/QC requirements of this part, except as provided in paragraphs (d)(2) and (d)(3) of this section. Best available monitoring methods means any of the following methods specified in this paragraph:

- (i) Monitoring methods currently used by the facility that do not meet the specifications of a relevant subpart.
  - (ii) Supplier data.
  - (iii) Engineering calculations.
  - (iv) Other company records.
- (2) **Requests for extension of the use of best available monitoring methods.** The owner or operator may submit a request to the Administrator to use one or more best available monitoring methods beyond March 31, 2010.
- (i) **Timing of request.** The extension request must be submitted to EPA no later than 30 days after the effective date of the GHG reporting rule.
  - (ii) **Content of request.** Requests must contain the following information:
    - (A) A list of specific item of monitoring instrumentation for which the request is being made and the locations where each piece of monitoring instrumentation will be installed.
    - (B) Identification of the specific rule requirements (by rule subpart, section, and paragraph numbers) for which the instrumentation is needed.
    - (C) A description of the reasons why the needed equipment could not be obtained and installed before April 1, 2010.
    - (D) If the reason for the extension is that the equipment cannot be purchased and delivered by April 1, 2010, include supporting documentation such as the date the monitoring equipment was ordered, investigation of alternative suppliers and the dates by which alternative vendors promised delivery, backorder notices or unexpected delays, descriptions of actions taken to expedite delivery, and the current expected date of delivery.
    - (E) If the reason for the extension is that the equipment cannot be installed without a process unit shutdown, include supporting documentation demonstrating that it is not practicable to isolate the equipment and install the monitoring instrument without a full process unit shutdown. Include the date of the most recent process unit shutdown, the frequency of shutdowns for this process unit, and the date of the next planned shutdown during which the monitoring equipment can be installed. If there has been a shutdown or if there is a planned process unit shutdown between promulgation of this part and April 1, 2010, include a justification of why the equipment could not be obtained and installed during that shutdown.

- (F) A description of the specific actions the facility will take to obtain and install the equipment as soon as reasonably feasible and the expected date by which the equipment will be installed and operating.
  - (iii) **Approval criteria.** To obtain approval, the owner or operator must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by April 1, 2010. The use of best available methods will not be approved beyond December 31, 2010.
- (3) **Abbreviated emissions report for facilities containing only general stationary fuel combustion sources.** In lieu of the report required by paragraph (c) of this section, the owner or operator of an existing facility that is in operation on January 1, 2010 and that meets the conditions of § 98.2(a)(3) may submit an abbreviated GHG report for the facility for GHGs emitted in 2010. The abbreviated report must be submitted by September 30, 2011. An owner or operator that submits an abbreviated report must submit a full GHG report according to the requirements of paragraph (c) of this section beginning in calendar year 2012. The abbreviated facility report must include the following information:
  - (i) Facility name and physical street address including the city, state and zip code.
  - (ii) The year and months covered by the report.
  - (iii) Date of submittal.
  - (iv) Total facility GHG emissions aggregated for all stationary fuel combustion units calculated according to any method specified in § 98.33(a) and expressed in metric tons of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and CO<sub>2</sub>e.
  - (v) For each stationary fuel combustion source that meets the criteria specified in § 98.36(f), report any facility operating data or process information used for the GHG emission calculations. A stationary fuel combustion source that does not meet the criteria specified in § 98.36(f) must either report the data specified in this paragraph (d)(3)(v) in the annual report or use verification software according to § 98.5(b) in lieu of reporting the data specified in this paragraph.
  - (vi) A signed and dated certification statement provided by the designated representative of the owner or operator, according to the requirements of paragraph (e)(1) of this section.
- (e) **Emission calculations.** In preparing the GHG report, you must use the calculation methodologies specified in the relevant subparts, except as specified in paragraph (d) of this section. For each source category, you must use the same calculation methodology throughout a reporting period unless you provide a written explanation of why a change in methodology was required.
- (f) **Verification.** To verify the completeness and accuracy of reported GHG emissions, the Administrator may review the certification statements described in paragraphs (c)(9) and (d)(3)(vi) of this section and any other credible evidence, in conjunction with a comprehensive review of the GHG reports and periodic audits of selected reporting facilities. Nothing in this section prohibits the Administrator from using additional information to verify the completeness and accuracy of the reports.
- (g) **Recordkeeping.** An owner or operator that is required to report GHGs under this part must keep records as specified in this paragraph (g). Except as otherwise provided in this paragraph, retain all required records for at least 3 years from the date of submission of the annual GHG report for the reporting year in which the record was generated. The records shall be kept in an electronic or hard-copy format (as appropriate)

and recorded in a form that is suitable for expeditious inspection and review. If the owner or operator of a facility is required under § 98.5(b) to use verification software specified by the Administrator, then all records required for the facility under this part must be retained for at least 5 years from the date of submission of the annual GHG report for the reporting year in which the record was generated, starting with records for reporting year 2010. Upon request by the Administrator, the records required under this section must be made available to EPA. Records may be retained off site if the records are readily available for expeditious inspection and review. For records that are electronically generated or maintained, the equipment or software necessary to read the records shall be made available, or, if requested by EPA, electronic records shall be converted to paper documents. You must retain the following records, in addition to those records prescribed in each applicable subpart of this part:

- (1) A list of all units, operations, processes, and activities for which GHG emission were calculated.
- (2) The data used to calculate the GHG emissions for each unit, operation, process, and activity, categorized by fuel or material type. These data include but are not limited to the following information in this paragraph (g)(2):
  - (i) The GHG emissions calculations and methods used. For data required by § 98.5(b) to be entered into verification software specified in § 98.5(b), maintain the entered data in the format generated by the verification software according to § 98.5(b).
  - (ii) Analytical results for the development of site-specific emissions factors.
  - (iii) The results of all required analyses for high heat value, carbon content, and other required fuel or feedstock parameters.
  - (iv) Any facility operating data or process information used for the GHG emission calculations.
- (3) The annual GHG reports.
- (4) Missing data computations. For each missing data event, also retain a record of the cause of the event and the corrective actions taken to restore malfunctioning monitoring equipment.
- (5) A written GHG Monitoring Plan.
  - (i) At a minimum, the GHG Monitoring Plan shall include the elements listed in this paragraph (g)(5)(i).
    - (A) Identification of positions of responsibility (i.e., job titles) for collection of the emissions data.
    - (B) Explanation of the processes and methods used to collect the necessary data for the GHG calculations.
    - (C) Description of the procedures and methods that are used for quality assurance, maintenance, and repair of all continuous monitoring systems, flow meters, and other instrumentation used to provide data for the GHGs reported under this part.
  - (ii) The GHG Monitoring Plan may rely on references to existing corporate documents (e.g., standard operating procedures, quality assurance programs under appendix F to 40 CFR part 60 or appendix B to 40 CFR part 75, and other documents) provided that the elements required by paragraph (g)(5)(i) of this section are easily recognizable.



- (iii) The owner or operator shall revise the GHG Monitoring Plan as needed to reflect changes in production processes, monitoring instrumentation, and quality assurance procedures; or to improve procedures for the maintenance and repair of monitoring systems to reduce the frequency of monitoring equipment downtime.
  - (iv) Upon request by the Administrator, the owner or operator shall make all information that is collected in conformance with the GHG Monitoring Plan available for review during an audit. Electronic storage of the information in the plan is permissible, provided that the information can be made available in hard copy upon request during an audit.
- (6) The results of all required certification and quality assurance tests of continuous monitoring systems, fuel flow meters, and other instrumentation used to provide data for the GHGs reported under this part.
- (7) Maintenance records for all continuous monitoring systems, flow meters, and other instrumentation used to provide data for the GHGs reported under this part.
- (h) **Annual GHG report revisions.** This paragraph applies to the reporting years for which the owner or operator is required to maintain records for a facility or supplier according to the time periods specified in paragraph (g) of this section.
  - (1) The owner or operator shall submit a revised annual GHG report within 45 days of discovering that an annual GHG report that the owner or operator previously submitted contains one or more substantive errors. The revised report must correct all substantive errors.
  - (2) The Administrator may notify the owner or operator in writing that an annual GHG report previously submitted by the owner or operator contains one or more substantive errors. Such notification will identify each such substantive error. The owner or operator shall, within 45 days of receipt of the notification, either resubmit the report that, for each identified substantive error, corrects the identified substantive error (in accordance with the applicable requirements of this part) or provide information demonstrating that the previously submitted report does not contain the identified substantive error or that the identified error is not a substantive error.
  - (3) A substantive error is an error that impacts the quantity of GHG emissions reported or otherwise prevents the reported data from being validated or verified.
  - (4) Notwithstanding paragraphs (h)(1) and (2) of this section, upon request by the owner or operator, the Administrator may provide reasonable extensions of the 45-day period for submission of the revised report or information under paragraphs (h)(1) and (2) of this section. If the Administrator receives a request for extension of the 45-day period, by email to an address prescribed by the Administrator prior to the expiration of the 45-day period, the extension request is deemed to be automatically granted for 30 days. The Administrator may grant an additional extension beyond the automatic 30-day extension if the owner or operator submits a request for an additional extension and the request is received by the Administrator prior to the expiration of the automatic 30-day extension, provided the request demonstrates that it is not practicable to submit a revised report or information under paragraphs (h)(1) and (2) of this section within 75 days. The Administrator will approve the extension request if the request demonstrates to the Administrator's satisfaction that it is not practicable to collect and process the data needed to resolve potential reporting errors identified pursuant to paragraph (h)(1) or (2) of this section within 75 days. The Administrator will only approve an extension request for a total of 180 days after the initial notification of a substantive error.

(5) The owner or operator shall retain documentation for 3 years to support any revision made to an annual GHG report.

(i) **Calibration accuracy requirements.** The owner or operator of a facility or supplier that is subject to the requirements of this part must meet the applicable flow meter calibration and accuracy requirements of this paragraph (i). The accuracy specifications in this paragraph (i) do not apply where either the use of company records (as defined in § 98.6) or the use of “best available information” is specified in an applicable subpart of this part to quantify fuel usage and/or other parameters. Further, the provisions of this paragraph (i) do not apply to stationary fuel combustion units that use the methodologies in part 75 of this chapter to calculate CO<sub>2</sub> mass emissions.

(1) Except as otherwise provided in paragraphs (i)(4) through (i)(6) of this section, flow meters that measure liquid and gaseous fuel feed rates, process stream flow rates, or feedstock flow rates and provide data for the GHG emissions calculations shall be calibrated prior to April 1, 2010 using the procedures specified in this paragraph (i) when such calibration is specified in a relevant subpart of this part. Each of these flow meters shall meet the applicable accuracy specification in paragraph (i)(2) or (i)(3) of this section. All other measurement devices (e.g., weighing devices) that are required by a relevant subpart of this part, and that are used to provide data for the GHG emissions calculations, shall also be calibrated prior to April 1, 2010; however, the accuracy specifications in paragraphs (i)(2) and (i)(3) of this section do not apply to these devices. Rather, each of these measurement devices shall be calibrated to meet the accuracy requirement specified for the device in the applicable subpart of this part, or, in the absence of such accuracy requirement, the device must be calibrated to an accuracy within the appropriate error range for the specific measurement technology, based on an applicable operating standard, including but not limited to manufacturer's specifications and industry standards. The procedures and methods used to quality-assure the data from each measurement device shall be documented in the written monitoring plan, pursuant to paragraph (g)(5)(i)(C) of this section.

(i) All flow meters and other measurement devices that are subject to the provisions of this paragraph (i) must be calibrated according to one of the following: You may use the manufacturer's recommended procedures; an appropriate industry consensus standard method; or a method specified in a relevant subpart of this part. The calibration method(s) used shall be documented in the monitoring plan required under paragraph (g) of this section.

(ii) For facilities and suppliers that become subject to this part after April 1, 2010, all flow meters and other measurement devices (if any) that are required by the relevant subpart(s) of this part to provide data for the GHG emissions calculations shall be installed no later than the date on which data collection is required to begin using the measurement device, and the initial calibration(s) required by this paragraph (i) (if any) shall be performed no later than that date.

(iii) Except as otherwise provided in paragraphs (i)(4) through (i)(6) of this section, subsequent recalibrations of the flow meters and other measurement devices subject to the requirements of this paragraph (i) shall be performed at one of the following frequencies:

(A) You may use the frequency specified in each applicable subpart of this part.

(B) You may use the frequency recommended by the manufacturer or by an industry consensus standard practice, if no recalibration frequency is specified in an applicable subpart.

- (2) Perform all flow meter calibration at measurement points that are representative of the normal operating range of the meter. Except for the orifice, nozzle, and venturi flow meters described in paragraph (i)(3) of this section, calculate the calibration error at each measurement point using Equation A-2 of this section. The terms "R" and "A" in Equation A-2 must be expressed in consistent units of measure (e.g., gallons/minute, ft<sup>3</sup>/min). The calibration error at each measurement point shall not exceed 5.0 percent of the reference value.

$$CE = \frac{|R - A|}{R} \times 100 \quad (\text{Eq. A-2})$$

where:

CE = Calibration error (%).

R = Reference value.

A = Flow meter response to the reference value.

- (3) For orifice, nozzle, and venturi flow meters, the initial quality assurance consists of in-situ calibration of the differential pressure (delta-P), total pressure, and temperature transmitters.

- (i) Calibrate each transmitter at a zero point and at least one upscale point. Fixed reference points, such as the freezing point of water, may be used for temperature transmitter calibrations. Calculate the calibration error of each transmitter at each measurement point, using Equation A-3 of this subpart. The terms "R," "A," and "FS" in Equation A-3 of this subpart must be in consistent units of measure (e.g., milliamperes, inches of water, psi, degrees). For each transmitter, the CE value at each measurement point shall not exceed 2.0 percent of full-scale. Alternatively, the results are acceptable if the sum of the calculated CE values for the three transmitters at each calibration level (i.e., at the zero level and at each upscale level) does not exceed 6.0 percent.

$$CE = \frac{|R - A|}{FS} \times 100 \quad (\text{Eq. A-3})$$

where:

CE = Calibration error (%).

R = Reference value.

A = Transmitter response to the reference value.

FS = Full-scale value of the transmitter.

- (ii) In cases where there are only two transmitters (i.e., differential pressure and either temperature or total pressure) in the immediate vicinity of the flow meter's primary element (e.g., the orifice plate), or when there is only a differential pressure transmitter in close proximity to the primary

element, calibration of these existing transmitters to a CE of 2.0 percent or less at each measurement point is still required, in accordance with paragraph (i)(3)(i) of this section; alternatively, when two transmitters are calibrated, the results are acceptable if the sum of the CE values for the two transmitters at each calibration level does not exceed 4.0 percent. However, note that installation and calibration of an additional transmitter (or transmitters) at the flow monitor location to measure temperature or total pressure or both is not required in these cases. Instead, you may use assumed values for temperature and/or total pressure, based on measurements of these parameters at a remote location (or locations), provided that the following conditions are met:

- (A) You must demonstrate that measurements at the remote location(s) can, when appropriate correction factors are applied, reliably and accurately represent the actual temperature or total pressure at the flow meter under all expected ambient conditions.
  - (B) You must make all temperature and/or total pressure measurements in the demonstration described in paragraph (i)(3)(ii)(A) of this section with calibrated gauges, sensors, transmitters, or other appropriate measurement devices. At a minimum, calibrate each of these devices to an accuracy within the appropriate error range for the specific measurement technology, according to one of the following. You may calibrate using a manufacturer's specification or an industry consensus standard.
  - (C) You must document the methods used for the demonstration described in paragraph (i)(3)(ii)(A) of this section in the written GHG Monitoring Plan under paragraph (g)(5)(i)(C) of this section. You must also include the data from the demonstration, the mathematical correlation(s) between the remote readings and actual flow meter conditions derived from the data, and any supporting engineering calculations in the GHG Monitoring Plan. You must maintain all of this information in a format suitable for auditing and inspection.
  - (D) You must use the mathematical correlation(s) derived from the demonstration described in paragraph (i)(3)(ii)(A) of this section to convert the remote temperature or the total pressure readings, or both, to the actual temperature or total pressure at the flow meter, or both, on a daily basis. You shall then use the actual temperature and total pressure values to correct the measured flow rates to standard conditions.
  - (E) You shall periodically check the correlation(s) between the remote and actual readings (at least once a year), and make any necessary adjustments to the mathematical relationship(s).
- (4) Fuel billing meters are exempted from the calibration requirements of this section and from the GHG Monitoring Plan and recordkeeping provisions of paragraphs (g)(5)(i)(C), (g)(6), and (g)(7) of this section, provided that the fuel supplier and any unit combusting the fuel do not have any common owners and are not owned by subsidiaries or affiliates of the same company. Meters used exclusively to measure the flow rates of fuels that are used for unit startup are also exempted from the calibration requirements of this section.
  - (5) For a flow meter that has been previously calibrated in accordance with paragraph (i)(1) of this section, an additional calibration is not required by the date specified in paragraph (i)(1) of this section if, as of that date, the previous calibration is still active (*i.e.*, the device is not yet due for recalibration because the time interval between successive calibrations has not elapsed). In this

case, the deadline for the successive calibrations of the flow meter shall be set according to one of the following. You may use either the manufacturer's recommended calibration schedule or you may use the industry consensus calibration schedule.

- (6) For units and processes that operate continuously with infrequent outages, it may not be possible to meet the April 1, 2010 deadline for the initial calibration of a flow meter or other measurement device without disrupting normal process operation. In such cases, the owner or operator may postpone the initial calibration until the next scheduled maintenance outage. The best available information from company records may be used in the interim. The subsequent required recalibrations of the flow meters may be similarly postponed. Such postponements shall be documented in the monitoring plan that is required under paragraph (g)(5) of this section.
- (7) If the results of an initial calibration or a recalibration fail to meet the required accuracy specification, data from the flow meter shall be considered invalid, beginning with the hour of the failed calibration and continuing until a successful calibration is completed. You shall follow the missing data provisions provided in the relevant missing data sections during the period of data invalidation.

(j) **Measurement device installation –**

- (1) **General.** If an owner or operator required to report under subpart P, subpart X or subpart Y of this part has process equipment or units that operate continuously and it is not possible to install a required flow meter or other measurement device by April 1, 2010, (or by any later date in 2010 approved by the Administrator as part of an extension of best available monitoring methods per paragraph (d) of this section) without process equipment or unit shutdown, or through a hot tap, the owner or operator may request an extension from the Administrator to delay installing the measurement device until the next scheduled process equipment or unit shutdown. If approval for such an extension is granted by the Administrator, the owner or operator must use best available monitoring methods during the extension period.
- (2) **Requests for extension of the use of best available monitoring methods for measurement device installation.** The owner or operator must first provide the Administrator an initial notification of the intent to submit an extension request for use of best available monitoring methods beyond December 31, 2010 (or an earlier date approved by EPA) in cases where measurement device installation would require a process equipment or unit shutdown, or could only be done through a hot tap. The owner or operator must follow-up this initial notification with the complete extension request containing the information specified in paragraph (j)(4) of this section.
- (3) **Timing of request.**
  - (i) The initial notice of intent must be submitted no later than January 1, 2011, or by the end of the approved use of best available monitoring methods extension in 2010, whichever is earlier. The completed extension request must be submitted to the Administrator no later than February 15, 2011.
  - (ii) Any subsequent extensions to the original request must be submitted to the Administrator within 4 weeks of the owner or operator identifying the need to extend the request, but in any event no later than 4 weeks before the date for the planned process equipment or unit shutdown that was provided in the original or most recently approved request.
- (4) **Content of the request.** Requests must contain the following information:

- (i) Specific measurement device for which the request is being made and the location where each measurement device will be installed.
  - (ii) Identification of the specific rule requirements (by rule subpart, section, and paragraph numbers) requiring the measurement device.
  - (iii) A description of the reasons why the needed equipment could not be installed before April 1, 2010, or by the expiration date for the use of best available monitoring methods, in cases where an extension has been granted under § 98.3(d).
  - (iv) Supporting documentation showing that it is not practicable to isolate the process equipment or unit and install the measurement device without a full shutdown or a hot tap, and that there was no opportunity during 2010 to install the device. Include the date of the three most recent shutdowns for each relevant process equipment or unit, the frequency of shutdowns for each relevant process equipment or unit, and the date of the next planned process equipment or unit shutdown.
  - (v) Include a description of the proposed best available monitoring method for estimating GHG emissions during the time prior to installation of the meter.
- (5) **Approval criteria.** The owner or operator must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to install the measurement device before April 1, 2010 (or by the expiration date for the use of best available monitoring methods, in cases where an extension has been granted under paragraph (d) of this section) without a process equipment or unit shutdown, or through a hot tap, and that the proposed method for estimating GHG emissions during the time before which the measurement device will be installed is appropriate. The Administrator will not initially approve the use of the proposed best available monitoring method past December 31, 2013.
- (6) **Measurement device installation deadline.** Any owner or operator that submits both a timely initial notice of intent and a timely completed extension request under paragraph (j)(3) of this section to extend use of best available monitoring methods for measurement device installation must install all such devices by July 1, 2011 unless the extension request under this paragraph (j) is approved by the Administrator before July 1, 2011.
- (7) **One time extension past December 31, 2013.** If an owner or operator determines that a scheduled process equipment or unit shutdown will not occur by December 31, 2013, the owner or operator may re-apply to use best available monitoring methods for one additional time period, not to extend beyond December 31, 2015. To extend use of best available monitoring methods past December 31, 2013, the owner or operator must submit a new extension request by June 1, 2013 that contains the information required in paragraph (j)(4) of this section. The owner or operator must demonstrate to the Administrator's satisfaction that it continues to not be reasonably feasible to install the measurement device before December 31, 2013 without a process equipment or unit shutdown, or that installation of the measurement device could only be done through a hot tap, and that the proposed method for estimating GHG emissions during the time before which the measurement device will be installed is appropriate. An owner or operator that submits a request under this paragraph to extend use of best available monitoring methods for measurement device installation must install all such devices by December 31, 2013, unless the extension request under this paragraph is approved by the Administrator.
- (k) **Revised global warming potentials and special provisions for reporting year 2013 and subsequent reporting years.** This paragraph (k) applies to owners or operators of facilities or suppliers that first become subject to any subpart of part 98 solely due to an amendment to Table A-1 of this subpart.

- (1) A facility or supplier that first becomes subject to part 98 due to a change in the GWP for one or more compounds in table A-1 to this subpart, Global Warming Potentials, is not required to submit an annual GHG report for the reporting year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking.
  - (2) A facility or supplier that was already subject to one or more subparts of this part but becomes subject to one or more additional subparts due to a change in the GWP for one or more compounds in table A-1 to this subpart, is not required to include those subparts to which the facility is subject only due to the change in the GWP in the annual GHG report submitted for the reporting year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking.
  - (3) Starting on January 1 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking, facilities or suppliers identified in paragraph (k)(1) or (2) of this section must start monitoring and collecting GHG data in compliance with the applicable subparts of part 98 to which the facility is subject due to the change in the GWP for the annual greenhouse gas report for that reporting year, which is due by March 31 of the following calendar year.
  - (4) A change in the GWP for one or more compounds includes the addition to Table A-1 of this subpart of either a chemical-specific or a default GWP that applies to a compound to which no chemical-specific GWP in Table A-1 of this subpart previously applied.
- (l) **Special provision for best available monitoring methods in 2014 and subsequent years.** This paragraph (l) applies to owners or operators of facilities or suppliers that first become subject to any subpart of this part due to an amendment to table A-1 to this subpart, Global Warming Potentials.
- (1) **Best available monitoring methods.** From January 1 to March 31 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking, owners or operators subject to this paragraph (l) may use best available monitoring methods for any parameter (e.g., fuel use, feedstock rates) that cannot reasonably be measured according to the monitoring and QA/QC requirements of a relevant subpart. The owner or operator must use the calculation methodologies and equations in the "Calculating GHG Emissions" sections of each relevant subpart, but may use the best available monitoring method for any parameter for which it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by January 1 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking. Starting no later than April 1 of the year after the year during which the change in GWPs is published, the owner or operator must discontinue using best available methods and begin following all applicable monitoring and QA/QC requirements of this part, except as provided in paragraph (l)(2) of this section. Best available monitoring methods means any of the following methods:
    - (i) Monitoring methods currently used by the facility that do not meet the specifications of a relevant subpart.
    - (ii) Supplier data.
    - (iii) Engineering calculations.
    - (iv) Other company records.

- (2) **Requests for extension of the use of best available monitoring methods.** The owner or operator may submit a request to the Administrator to use one or more best available monitoring methods beyond March 31 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking.
- (i) **Timing of request.** The extension request must be submitted to EPA no later than January 31 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking.
- (ii) **Content of request.** Requests must contain the following information:
- (A) A list of specific items of monitoring instrumentation for which the request is being made and the locations where each piece of monitoring instrumentation will be installed.
  - (B) Identification of the specific rule requirements (by rule subpart, section, and paragraph numbers) for which the instrumentation is needed.
  - (C) A description of the reasons that the needed equipment could not be obtained and installed before April 1 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking.
  - (D) If the reason for the extension is that the equipment cannot be purchased and delivered by April 1 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking, include supporting documentation such as the date the monitoring equipment was ordered, investigation of alternative suppliers and the dates by which alternative vendors promised delivery, backorder notices or unexpected delays, descriptions of actions taken to expedite delivery, and the current expected date of delivery.
  - (E) If the reason for the extension is that the equipment cannot be installed without a process unit shutdown, include supporting documentation demonstrating that it is not practicable to isolate the equipment and install the monitoring instrument without a full process unit shutdown. Include the date of the most recent process unit shutdown, the frequency of shutdowns for this process unit, and the date of the next planned shutdown during which the monitoring equipment can be installed. If there has been a shutdown or if there is a planned process unit shutdown between November 29 of the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking and April 1 of the year after the year during which the change in GWPs is published, include a justification of why the equipment could not be obtained and installed during that shutdown.
  - (F) A description of the specific actions the facility will take to obtain and install the equipment as soon as reasonably feasible and the expected date by which the equipment will be installed and operating.
- (iii) **Approval criteria.** To obtain approval, the owner or operator must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by April 1 of the year after the year during which the change in GWPs is published in the FEDERAL REGISTER as a final rulemaking. The use of best available methods under this paragraph (l) will not be approved beyond December 31 of the year after the year during which the change in GWPs is published.



[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 39758, July 12, 2010; 75 FR 57685, Sept. 22, 2010; 75 FR 74816, Dec. 1, 2010; 75 FR 79134, Dec. 17, 2010; 75 FR 81344, Dec. 27, 2010; 76 FR 14818, Mar. 18, 2011; 76 FR 53065, Aug. 25, 2011; 76 FR 73899, Nov. 29, 2011; 77 FR 51488, Aug. 24, 2012; 78 FR 71946, Nov. 29, 2013; 79 FR 63779, Oct. 24, 2014; 79 FR 73777, Dec. 11, 2014; 79 FR 77391, Dec. 24, 2014; 81 FR 89249, Dec. 9, 2016; 89 FR 31890, Apr. 25, 2024; 89 FR 91164, Nov. 18, 2024; 90 FR 13088, Mar. 20, 2025; 90 FR 21227, May 19, 2025; 91 FR 9718, Feb. 27, 2026]

## § 98.4 Authorization and responsibilities of the designated representative.

- (a) **General.** Except as provided under paragraph (f) of this section, each facility, and each supplier, that is subject to this part, shall have one and only one designated representative, who shall be responsible for certifying, signing, and submitting GHG emissions reports and any other submissions for such facility and supplier respectively to the Administrator under this part. If the facility is required under any other part of title 40 of the Code of Federal Regulations to submit to the Administrator any other emission report that is subject to any requirement in 40 CFR part 75, the same individual shall be the designated representative responsible for certifying, signing, and submitting the GHG emissions reports and all such other emissions reports under this part.
- (b) **Authorization of a designated representative.** The designated representative of the facility or supplier shall be an individual selected by an agreement binding on the owners and operators of such facility or supplier and shall act in accordance with the certification statement in paragraph (i)(4)(iv) of this section.
- (c) **Responsibility of the designated representative.** Upon receipt by the Administrator of a complete certificate of representation under this section for a facility or supplier, the designated representative identified in such certificate of representation shall represent and, by his or her representations, actions, inactions, or submissions, legally bind each owner and operator of such facility or supplier in all matters pertaining to this part, notwithstanding any agreement between the designated representative and such owners and operators. The owners and operators shall be bound by any decision or order issued to the designated representative by the Administrator or a court.
- (d) **Timing.** No GHG emissions report or other submissions under this part for a facility or supplier will be accepted until the Administrator has received a complete certificate of representation under this section for a designated representative of the facility or supplier. Such certificate of representation shall be submitted at least 60 days before the deadline for submission of the facility's or supplier's initial emission report under this part.
- (e) **Certification of the GHG emissions report.** Each GHG emission report and any other submission under this part for a facility or supplier shall be certified, signed, and submitted by the designated representative or any alternate designated representative of the facility or supplier in accordance with this section and § 3.10 of this chapter.
  - (1) Each such submission shall include the following certification statement signed by the designated representative or any alternate designated representative: "I am authorized to make this submission on behalf of the owners and operators of the facility or supplier, as applicable, for which the submission is made. I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment."

- (2) The Administrator will accept a GHG emission report or other submission for a facility or supplier under this part only if the submission is certified, signed, and submitted in accordance with this section.

(f) **Alternate designated representative.** A certificate of representation under this section for a facility or supplier may designate one alternate designated representative, who shall be an individual selected by an agreement binding on the owners and operators, and may act on behalf of the designated representative, of such facility or supplier. The agreement by which the alternate designated representative is selected shall include a procedure for authorizing the alternate designated representative to act in lieu of the designated representative.

- (1) Upon receipt by the Administrator of a complete certificate of representation under this section for a facility or supplier identifying an alternate designated representative.

- (i) The alternate designated representative may act on behalf of the designated representative for such facility or supplier.

- (ii) Any representation, action, inaction, or submission by the alternate designated representative shall be deemed to be a representation, action, inaction, or submission by the designated representative.

- (2) Except in this section, whenever the term “designated representative” is used in this part, the term shall be construed to include the designated representative or any alternate designated representative.

(g) **Changing a designated representative or alternate designated representative.** The designated representative or alternate designated representative identified in a complete certificate of representation under this section for a facility or supplier received by the Administrator may be changed at any time upon receipt by the Administrator of another later signed, complete certificate of representation under this section for the facility or supplier. Notwithstanding any such change, all representations, actions, inactions, and submissions by the previous designated representative or the previous alternate designated representative of the facility or supplier before the time and date when the Administrator receives such later signed certificate of representation shall be binding on the new designated representative and the owners and operators of the facility or supplier.

(h) **Changes in owners and operators.** Except as provided in paragraph (n) of this section, in the event an owner or operator of the facility or supplier is not included in the list of owners and operators in the certificate of representation under this section for the facility or supplier, such owner or operator shall be deemed to be subject to and bound by the certificate of representation, the representations, actions, inactions, and submissions of the designated representative and any alternate designated representative of the facility or supplier, as if the owner or operator were included in such list. Within 90 days after any change in the owners and operators of the facility or supplier (including the addition of a new owner or operator), the designated representative or any alternate designated representative shall submit a certificate of representation that is complete under this section except that such list shall be amended to reflect the change. If the designated representative or alternate designated representative determines at any time that an owner or operator of the facility or supplier is not included in such list and such exclusion is not the result of a change in the owners and operators, the designated representative or any alternate designated representative shall submit, within 90 days of making such determination, a certificate of representation that is complete under this section except that such list shall be amended to include such owner or operator.

- (i) **Certificate of representation.** A certificate of representation shall be complete if it includes the following elements in a format prescribed by the Administrator in accordance with this section:
  - (1) Identification of the facility or supplier for which the certificate of representation is submitted.
  - (2) The name, organization name (company affiliation-employer), address, e-mail address (if any), telephone number, and facsimile transmission number (if any) of the designated representative and any alternate designated representative.
  - (3) A list of the owners and operators of the facility or supplier identified in paragraph (i)(1) of this section, provided that, if the list includes the operators of the facility or supplier and the owners with control of the facility or supplier, the failure to include any other owners shall not make the certificate of representation incomplete.
  - (4) The following certification statements by the designated representative and any alternate designated representative:
    - (i) "I certify that I was selected as the designated representative or alternate designated representative, as applicable, by an agreement binding on the owners and operators of the facility or supplier, as applicable."
    - (ii) "I certify that I have all the necessary authority to carry out my duties and responsibilities under 40 CFR part 98 on behalf of the owners and operators of the facility or supplier, as applicable, and that each such owner and operator shall be fully bound by my representations, actions, inactions, or submissions."
    - (iii) "I certify that the owners and operators of the facility or supplier, as applicable, shall be bound by any order issued to me by the Administrator or a court regarding the facility or supplier."
    - (iv) "If there are multiple owners and operators of the facility or supplier, as applicable, I certify that I have given a written notice of my selection as the 'designated representative' or 'alternate designated representative', as applicable, and of the agreement by which I was selected to each owner and operator of the facility or supplier."
  - (5) The signature of the designated representative and any alternate designated representative and the dates signed.
  - (6) A list of the subparts that the owners and operators anticipate will be included in the annual GHG report. The list of potentially applicable subparts is required only for an initial certificate of representation that is submitted after January 1, 2018 (i.e., for a facility or supplier that previously was not registered under this part). The list of potentially applicable subparts does not need to be revised with revisions to the COR or if the actual applicable subparts change.
- (j) **Documents of agreement.** Unless otherwise required by the Administrator, documents of agreement referred to in the certificate of representation shall not be submitted to the Administrator. The Administrator shall not be under any obligation to review or evaluate the sufficiency of such documents, if submitted.
- (k) **Binding nature of the certificate of representation.** Once a complete certificate of representation under this section for a facility or supplier has been received, the Administrator will rely on the certificate of representation unless and until a later signed, complete certificate of representation under this section for the facility or supplier is received by the Administrator.
- (l) **Objections concerning a designated representative.**

- (1) Except as provided in paragraph (g) of this section, no objection or other communication submitted to the Administrator concerning the authorization, or any representation, action, inaction, or submission, of the designated representative or alternate designated representative shall affect any representation, action, inaction, or submission of the designated representative or alternate designated representative, or the finality of any decision or order by the Administrator under this part.
- (2) The Administrator will not adjudicate any private legal dispute concerning the authorization or any representation, action, inaction, or submission of any designated representative or alternate designated representative.

(m) *Delegation by designated representative and alternate designated representative.*

- (1) A designated representative or an alternate designated representative may delegate his or her own authority, to one or more individuals, to submit an electronic submission to the Administrator provided for or required under this part, except for a submission under this paragraph.
- (2) In order to delegate his or her own authority, to one or more individuals, to submit an electronic submission to the Administrator in accordance with paragraph (m)(1) of this section, the designated representative or alternate designated representative must submit electronically to the Administrator a notice of delegation, in a format prescribed by the Administrator, that includes the following elements:
  - (i) The name, organization name (company affiliation-employer) address, e-mail address (if any), telephone number, and facsimile transmission number (if any) of such designated representative or alternate designated representative.
  - (ii) The name, address, e-mail address, telephone number, and facsimile transmission number (if any) of each such individual (referred to as an "agent").
  - (iii) For each such individual, a list of the type or types of electronic submissions under paragraph (m)(1) of this section for which authority is delegated to him or her.
  - (iv) For each type of electronic submission listed in accordance with paragraph (m)(2)(iii) of this section, the facility or supplier for which the electronic submission may be made.
  - (v) The following certification statements by such designated representative or alternate designated representative:
    - (A) "I agree that any electronic submission to the Administrator that is by an agent identified in this notice of delegation and of a type listed, and for a facility or supplier designated, for such agent in this notice of delegation and that is made when I am a designated representative or alternate designated representative, as applicable, and before this notice of delegation is superseded by another notice of delegation under § 98.4(m)(3) shall be deemed to be an electronic submission certified, signed, and submitted by me."
    - (B) "Until this notice of delegation is superseded by a later signed notice of delegation under § 98.4(m)(3), I agree to maintain an e-mail account and to notify the Administrator immediately of any change in my e-mail address unless all delegation of authority by me under § 98.4(m) is terminated."
  - (vi) The signature of such designated representative or alternate designated representative and the date signed.

- (3) A notice of delegation submitted in accordance with paragraph (m)(2) of this section shall be effective, with regard to the designated representative or alternate designated representative identified in such notice, upon receipt of such notice by the Administrator and until receipt by the Administrator of another such notice that was signed later by such designated representative or alternate designated representative, as applicable. The later signed notice of delegation may replace any previously identified agent, add a new agent, or eliminate entirely any delegation of authority.
- (4) Any electronic submission covered by the certification in paragraph (m)(2)(v)(A) of this section and made in accordance with a notice of delegation effective under paragraph (m)(3) of this section shall be deemed to be an electronic submission certified, signed, and submitted by the designated representative or alternate designated representative submitting such notice of delegation.

(n) ***Alternative provisions for changes in owners and operators for industry segments with a unique definition of facility as defined in § 98.238.*** When there is a change to the owner or operator of a facility required to report under the onshore petroleum and natural gas production, natural gas distribution, onshore petroleum and natural gas gathering and boosting, or onshore natural gas transmission pipeline industry segments of subpart W of this part, or a change to the owner or operator for some emission sources from the facility in one of these industry segments, the provisions specified in paragraphs (n)(1) through (4) of this section apply for the respective type of change in owner or operator.

- (1) If the entire facility is acquired by an owner or operator that does not already have a reporting facility in the same industry segment and basin (for onshore petroleum and natural gas production or onshore petroleum and natural gas gathering and boosting) or state (for natural gas distribution), then within 90 days after the change in the owner or operator, the designated representative or any alternate designated representative shall submit a certificate of representation that is complete under this section. If the new owner or operator already had emission sources specified in § 98.232(c), (i), (j), or (m), as applicable, prior to the acquisition in the same basin (for onshore petroleum and natural gas production or onshore petroleum and natural gas gathering and boosting) or state (for natural gas distribution) as the acquired facility but had not previously met the applicability requirements in §§ 98.2(a) and 98.231, then per the applicable definition of facility in § 98.238, the previously owned applicable emission sources must be included in the acquired facility. The new owner or operator and the new designated representative shall be responsible for submitting the annual report for the facility for the entire reporting year beginning with the reporting year in which the acquisition occurred.
- (2) If the entire facility is acquired by an owner or operator that already has a reporting facility in the same industry segment and basin (for onshore petroleum and natural gas production or onshore petroleum and natural gas gathering and boosting) or state (for natural gas distribution), the new owner or operator shall merge the acquired facility with their existing facility for purposes of the annual greenhouse gas (GHG) report. The owner or operator shall also follow the provisions of § 98.2(i)(6) to notify EPA that the acquired facility will discontinue reporting and shall provide the e-GGRT identification number of the merged, or reconstituted, facility. The owner or operator of the merged facility shall be responsible for submitting the annual report for the merged facility for the entire reporting year beginning with the reporting year in which the acquisition occurred.
- (3) If only some emission sources from the facility are acquired by one or more new owners or operators, the existing owner or operator (i.e., the owner or operator of the portion of the facility that is not sold) shall continue to report under subpart W of this part for the retained emission sources

unless and until that facility meets one of the criteria in § 98.2(i). Each owner or operator that acquires emission sources from the facility must account for those acquired emission sources according to paragraph (n)(3)(i) or (ii) of this section, as applicable.

- (i) If the purchasing owner or operator that acquires only some of the emission sources from the existing facility does not already have a reporting facility in the same industry segment and basin (for onshore petroleum and natural gas production or onshore petroleum and natural gas gathering and boosting) or state (for natural gas distribution), the purchasing owner or operator shall begin reporting as a new facility. The new facility must include the acquired emission sources specified in § 98.232(c), (i), (j), or (m), as applicable, and any emission sources the purchasing owner or operator already owned in the same industry segment and basin (for onshore petroleum and natural gas production or onshore petroleum and natural gas gathering and boosting) or state (for natural gas distribution). The designated representative for the new facility must be selected by the purchasing owner or operator according to the schedule and procedure specified in paragraphs (b) through (d) of this section. The purchasing owner or operator shall be responsible for submitting the annual report for the new facility for the entire reporting year beginning with the reporting year in which the acquisition occurred. The purchasing owner or operator shall continue to report under subpart W of this part for the new facility unless and until that facility meets one of the criteria in § 98.2(i).
  - (ii) If the purchasing owner or operator that acquires only some of the emission sources from the existing facility already has a reporting facility in the same industry segment and basin (for onshore petroleum and natural gas production or onshore petroleum and natural gas gathering and boosting) or state (for natural gas distribution), then per the applicable definition of facility in § 98.238, the purchasing owner or operator must add the acquired emission sources specified in § 98.232(c), (i), (j), or (m), as applicable, to their existing facility for purposes of reporting under subpart W of this part. The purchasing owner or operator shall be responsible for submitting the annual report for the entire facility, including the acquired emission sources, for the entire reporting year beginning with the reporting year in which the acquisition occurred.
- (4) If all the emission sources from a reporting facility are sold to multiple owners or operators within the same reporting year, such that the prior owner or operator of the facility does not retain any of the emission sources, then the prior owner or operator of the facility shall notify EPA within 90 days of the last transaction that all of the facility's emission sources were acquired by multiple purchasers, including the identity of the purchasers. Each owner or operator that acquires emission sources from a facility shall account for those sources according to paragraph (n)(3)(i) or (ii) of this section, as applicable.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79137, Dec. 17, 2010; 76 FR 73900, Nov. 29, 2011; 81 FR 89249, Dec. 9, 2016; 89 FR 42218, May 14, 2024; 89 FR 91164, Nov. 18, 2024; 90 FR 21227, May 19, 2025]

## § 98.5 How is the report submitted?

- (a) Each GHG report and certificate of representation for a facility or supplier must be submitted electronically in accordance with the requirements of § 98.4 and in a format specified by the Administrator.
- (b) For reporting year 2014 and thereafter, unless a later year is specified in the applicable recordkeeping section, you must enter into verification software specified by the Administrator the data specified as verification software records in each applicable recordkeeping section. For each data element entered

into the verification software, if the software produces a warning message for the data value and you elect not to revise the data value, you may provide an explanation in the verification software of why the data value is not being revised.

[79 FR 63780, Oct. 24, 2014, as amended at 79 FR 73778, Dec. 11, 2014; 89 FR 31891, Apr. 25, 2024]

## § 98.6 Definitions.

All terms used in this part shall have the same meaning given in the Clean Air Act and in this section.

**Absorbent circulation pump** means a pump commonly powered by natural gas pressure that circulates the absorbent liquid between the absorbent regenerator and natural gas contactor.

**Accuracy** of a measurement at a specified level (e.g., one percent of full scale or one percent of the value measured) means that the mean of repeat measurements made by a device or technique are within 95 percent of the range bounded by the true value plus or minus the specified level.

**Acid Rain Program** means the program established under title IV of the Clean Air Act, and implemented under parts 72 through 78 of this chapter for the reduction of sulfur dioxide and nitrogen oxides emissions.

**Administrator** means the Administrator of the United States Environmental Protection Agency or the Administrator's authorized representative.

**AGA** means the American Gas Association

**Agricultural by-products** means those parts of arable crops that are not used for the primary purpose of producing food. Agricultural by-products include, but are not limited to, oat, corn and wheat straws, bagasse, peanut shells, rice and coconut husks, soybean hulls, palm kernel cake, cottonseed and sunflower seed cake, and pomace.

**Air injected flare** means a flare in which air is blown into the base of a flare stack to induce complete combustion of gas.

**Alkali bypass** means a duct between the feed end of the kiln and the preheater tower through which a portion of the kiln exit gas stream is withdrawn and quickly cooled by air or water to avoid excessive buildup of alkali, chloride and/or sulfur on the raw feed. This may also be referred to as the "kiln exhaust gas bypass."

**Anaerobic digester** means the system where wastes are collected and anaerobically digested in large containment vessels or covered lagoons. Anaerobic digesters stabilize waste by the microbial reduction of complex organic compounds to CO<sub>2</sub> and CH<sub>4</sub>, which is captured and may be flared or used as fuel. Anaerobic digestion systems, include but are not limited to covered lagoon, complete mix, plug flow, and fixed film digesters.

**Anaerobic lagoon**, with respect to subpart JJ of this part, means a type of liquid storage system component that is designed and operated to stabilize wastes using anaerobic microbial processes. Anaerobic lagoons may be designed for combined stabilization and storage with varying lengths of retention time (up to a year or greater), depending on the climate region, volatile solids loading rate, and other operational factors.

**Anode effect** is a process upset condition of an aluminum electrolysis cell caused by too little alumina dissolved in the electrolyte. The anode effect begins when the voltage rises rapidly and exceeds a threshold voltage, typically 8 volts.

*Anode Effect Minutes per Cell Day (24 hours)* are the total minutes during which an electrolysis cell voltage is above the threshold voltage, typically 8 volts.

*ANSI* means the American National Standards Institute.

*API* means the American Petroleum Institute.

*ASABE* means the American Society of Agricultural and Biological Engineers.

*ASME* means the American Society of Mechanical Engineers.

*ASTM* means ASTM, International.

*Asphalt* means a dark brown-to-black cement-like material obtained by petroleum processing and containing bitumens as the predominant component. It includes crude asphalt as well as the following finished products: cements, fluxes, the asphalt content of emulsions (exclusive of water), and petroleum distillates blended with asphalt to make cutback asphalts.

*Aviation Gasoline* means a complex mixture of volatile hydrocarbons, with or without additives, suitably blended to be used in aviation reciprocating engines. Specifications can be found in ASTM Specification D910-07a, Standard Specification for Aviation Gasolines (incorporated by reference, see § 98.7).

*B<sub>0</sub>* means the maximum CH<sub>4</sub> producing capacity of a waste stream, kg CH<sub>4</sub>/kg COD.

*Basic oxygen furnace* means any refractory-lined vessel in which high-purity oxygen is blown under pressure through a bath of molten iron, scrap metal, and fluxes to produce steel.

*bbl* means barrel.

*Biodiesel* means a mono-alkyl ester derived from biomass and conforming to ASTM D6751-08, Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels.

*Biogenic CO<sub>2</sub>* means carbon dioxide emissions generated as the result of biomass combustion from combustion units for which emission calculations are required by an applicable part 98 subpart.

*Biomass* means non-fossilized and biodegradable organic material originating from plants, animals or micro-organisms, including products, by-products, residues and waste from agriculture, forestry and related industries as well as the non-fossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material.

*Blast furnace* means a furnace that is located at an integrated iron and steel plant and is used for the production of molten iron from iron ore pellets and other iron bearing materials.

*Blendstocks* are petroleum products used for blending or compounding into finished motor gasoline. These include RBOB (reformulated blendstock for oxygenate blending) and CBOB (conventional blendstock for oxygenate blending), but exclude oxygenates, butane, and pentanes plus.

*Blendstocks—Others* are products used for blending or compounding into finished motor gasoline that are not defined elsewhere. Excludes Gasoline Treated as Blendstock (GTAB), Diesel Treated as Blendstock (DTAB), conventional blendstock for oxygenate blending (CBOB), reformulated blendstock for oxygenate blending (RBOB), oxygenates (e.g. fuel ethanol and methyl tertiary butyl ether), butane, and pentanes plus.

*Blowdown* mean the act of emptying or depressuring a vessel. This may also refer to the discarded material such as blowdown water from a boiler or cooling tower.



**Blowdown vent stack** emissions mean natural gas and/or CO<sub>2</sub> released due to maintenance and/or blowdown operations including compressor blowdown and emergency shut-down (ESD) system testing.

**British Thermal Unit or Btu** means the quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit at about 39.2 degrees Fahrenheit.

**Bulk**, with respect to industrial GHG suppliers and CO<sub>2</sub> suppliers, means a transfer of gas in any amount that is in a container for the transportation or storage of that substance such as cylinders, drums, ISO tanks, and small cans. An industrial gas or CO<sub>2</sub> that must first be transferred from a container to another container, vessel, or piece of equipment in order to realize its intended use is a bulk substance. An industrial GHG or CO<sub>2</sub> that is contained in a manufactured product such as electrical equipment, appliances, aerosol cans, or foams is not a bulk substance.

**Bulk natural gas liquid or NGL** refers to mixtures of hydrocarbons that have been separated from natural gas as liquids through the process of absorption, condensation, adsorption, or other methods. Generally, such liquids consist of ethane, propane, butanes, and pentanes plus. Bulk NGL is sold to fractionators or to refineries and petrochemical plants where the fractionation takes place.

**Butane**, or n-Butane, is a paraffinic straight-chain hydrocarbon with molecular formula C<sub>4</sub>H<sub>10</sub>.

**Butylene**, or n-Butylene, is an olefinic straight-chain hydrocarbon with molecular formula C<sub>4</sub>H<sub>8</sub>.

**By-product coke oven battery** means a group of ovens connected by common walls, where coal undergoes destructive distillation under positive pressure to produce coke and coke oven gas from which by-products are recovered.

**Calcination** means the process of thermally treating minerals to decompose carbonates from ore.

**Calculation methodology** means a methodology prescribed under the section “Calculating GHG Emissions” in any subpart of part 98.

**Calibrated bag** means a flexible, non-elastic, anti-static bag of a calibrated volume that can be affixed to an emitting source such that the emissions inflate the bag to its calibrated volume.

**Carbon dioxide equivalent or CO<sub>2</sub>e** means the number of metric tons of CO<sub>2</sub> emissions with the same global warming potential as one metric ton of another greenhouse gas, and is calculated using Equation A-1 of this subpart.

**Carbon dioxide production well** means any hole drilled in the earth for the primary purpose of extracting carbon dioxide from a geologic formation or group of formations which contain deposits of carbon dioxide.

**Carbon dioxide production well facility** means one or more carbon dioxide production wells that are located on one or more contiguous or adjacent properties, which are under the control of the same entity. Carbon dioxide production wells located on different oil and gas leases, mineral fee tracts, lease tracts, subsurface or surface unit areas, surface fee tracts, surface lease tracts, or separate surface sites, whether or not connected by a road, waterway, power line, or pipeline, shall be considered part of the same CO<sub>2</sub> production well facility if they otherwise meet the definition.

**Carbon dioxide stream** means carbon dioxide that has been captured from an emission source (e.g., a power plant or other industrial facility), captured from ambient air (e.g., direct air capture), or extracted from a carbon dioxide production well plus incidental associated substances either derived from the source materials and the capture process or extracted with the carbon dioxide.

**Carbon share** means the percent of total mass that carbon represents in any product.

**Carbonate** means compounds containing the radical  $\text{CO}_3^{-2}$ . Upon calcination, the carbonate radical decomposes to evolve carbon dioxide ( $\text{CO}_2$ ). Common carbonates consumed in the mineral industry include calcium carbonate ( $\text{CaCO}_3$ ) or calcite; magnesium carbonate ( $\text{MgCO}_3$ ) or magnesite; and calcium-magnesium carbonate ( $\text{CaMg}(\text{CO}_3)_2$ ) or dolomite.

**Carbonate-based mineral** means any of the following minerals used in the manufacture of glass: Calcium carbonate ( $\text{CaCO}_3$ ), calcium magnesium carbonate ( $\text{CaMg}(\text{CO}_3)_2$ ), sodium carbonate ( $\text{Na}_2\text{CO}_3$ ), barium carbonate ( $\text{BaCO}_3$ ), potassium carbonate ( $\text{K}_2\text{CO}_3$ ), lithium carbonate ( $\text{Li}_2\text{CO}_3$ ), and strontium carbonate ( $\text{SrCO}_3$ ).

**Carbonate-based mineral mass fraction** means the following: For limestone, the mass fraction of calcium carbonate ( $\text{CaCO}_3$ ) in the limestone; for dolomite, the mass fraction of calcium magnesium carbonate ( $\text{CaMg}(\text{CO}_3)_2$ ) in the dolomite; for soda ash, the mass fraction of sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) in the soda ash; for barium carbonate, the mass fraction of barium carbonate ( $\text{BaCO}_3$ ) in the barium carbonate; for potassium carbonate, the mass fraction of potassium carbonate ( $\text{K}_2\text{CO}_3$ ) in the potassium carbonate; for lithium carbonate, the mass fraction of lithium carbonate ( $\text{Li}_2\text{CO}_3$ ); and for strontium carbonate, the mass fraction of strontium carbonate ( $\text{SrCO}_3$ ).

**Carbonate-based raw material** means any of the following materials used in the manufacture of glass: Limestone, dolomite, soda ash, barium carbonate, potassium carbonate, lithium carbonate, and strontium carbonate.

**Carbonofluoridates** means fluorinated GHGs that are composed of a  $-\text{OCF}(\text{O})$  group (carbonyl group with a single-bonded oxygen atom and a fluorine atom) that is linked on the single-bonded oxygen to another hydrocarbon group in which one or more of the hydrogen atoms may be replaced by fluorine atoms.

**Catalytic cracking unit** means a refinery process unit in which petroleum derivatives are continuously charged and hydrocarbon molecules in the presence of a catalyst are fractured into smaller molecules, or react with a contact material suspended in a fluidized bed to improve feedstock quality for additional processing and the catalyst or contact material is continuously regenerated by burning off coke and other deposits. Catalytic cracking units include both fluidized bed systems, which are referred to as fluid catalytic cracking units (FCCU), and moving bed systems, which are also referred to as thermal catalytic cracking units. The unit includes the riser, reactor, regenerator, air blowers, spent catalyst or contact material stripper, catalyst or contact material recovery equipment, and regenerator equipment for controlling air pollutant emissions and for heat recovery.

**CBOB-Summer** (conventional blendstock for oxygenate blending) means a petroleum product which, when blended with a specified type and percentage of oxygenate, meets the definition of Conventional-Summer.

**CBOB-Winter** (conventional blendstock for oxygenate blending) means a petroleum product which, when blended with a specified type and percentage of oxygenate, meets the definition of Conventional-Winter.

**Cement kiln dust** means non-calcined to fully calcined dust produced in the kiln or pyroprocessing line. Cement kiln dust is a fine-grained, solid, highly alkaline material removed from the cement kiln exhaust gas by scrubbers (filtration baghouses and/or electrostatic precipitators).

**Centrifugal compressor** means any equipment that increases the pressure of a process natural gas or  $\text{CO}_2$  by centrifugal action, employing rotating movement of the driven shaft.

**Centrifugal compressor dry seal emissions** mean natural gas or  $\text{CO}_2$  released from a dry seal vent pipe and/or the seal face around the rotating shaft where it exits one or both ends of the compressor case.

**Centrifugal compressor dry seals** mean a series of rings around the compressor shaft where it exits the compressor case that operates mechanically under the opposing forces to prevent natural gas or CO<sub>2</sub> from escaping to the atmosphere.

**Centrifugal compressor wet seal degassing vent emissions** means emissions that occur when the high-pressure oil barriers for centrifugal compressors are depressurized to release absorbed natural gas or CO<sub>2</sub>. High-pressure oil is used as a barrier against escaping gas in centrifugal compressor shafts. Very little gas escapes through the oil barrier, but under high pressure, considerably more gas is absorbed by the oil. The seal oil is purged of the absorbed gas (using heaters, flash tanks, and degassing techniques) and recirculated. The separated gas is commonly vented to the atmosphere.

**Certified standards** means calibration gases certified by the manufacturer of the calibration gases to be accurate to within 2 percent of the value on the label or calibration gases.

**CH<sub>4</sub>** means methane.

**Chemical recovery combustion unit** means a combustion device, such as a recovery furnace or fluidized-bed reactor where spent pulping liquor from sulfite or semi-chemical pulping processes is burned to recover pulping chemicals.

**Chemical recovery furnace** means an enclosed combustion device where concentrated spent liquor produced by the kraft or soda pulping process is burned to recover pulping chemicals and produce steam. Includes any recovery furnace that burns spent pulping liquor produced from both the kraft and soda pulping processes.

**Chloride process** means a production process where titanium dioxide is produced using calcined petroleum coke and chlorine as raw materials.

**City gate** means a location at which natural gas ownership or control passes from one party to another, neither of which is the ultimate consumer. In this rule, in keeping with common practice, the term refers to a point or measuring station at which a local gas distribution utility receives gas from a natural gas pipeline company or transmission system. Meters at the city gate station measure the flow of natural gas into the local distribution company system and typically are used to measure local distribution company system sendout to customers.

**CO<sub>2</sub>** means carbon dioxide.

**Coal** means all solid fuels classified as anthracite, bituminous, sub-bituminous, or lignite by the American Society for Testing and Materials Designation ASTM D388-05 Standard Classification of Coals by Rank (incorporated by reference, see § 98.7).

**COD** means the chemical oxygen demand as determined using methods specified pursuant to 40 CFR part 136.

**Cogeneration unit** means a unit that produces electrical energy and useful thermal energy for industrial, commercial, or heating or cooling purposes, through the sequential or simultaneous use of the original fuel energy.

**Coke burn-off** means the coke removed from the surface of a catalyst by combustion during catalyst regeneration. Coke burn-off also means the coke combusted in fluid coking unit burner.

**Cokemaking** means the production of coke from coal in either a by-product coke oven battery or a non-recovery coke oven battery.

**Commercial applications** means executing a commercial transaction subject to a contract. A commercial application includes transferring custody of a product from one facility to another if it otherwise meets the definition.

**Company records** means, in reference to the amount of fuel consumed by a stationary combustion unit (or by a group of such units), a complete record of the methods used, the measurements made, and the calculations performed to quantify fuel usage. Company records may include, but are not limited to, direct measurements of fuel consumption by gravimetric or volumetric means, tank drop measurements, and calculated values of fuel usage obtained by measuring auxiliary parameters such as steam generation or unit operating hours. Fuel billing records obtained from the fuel supplier qualify as company records.

**Connector** means to flanged, screwed, or other joined fittings used to connect pipe line segments, tubing, pipe components (such as elbows, reducers, “T’s” or valves) or a pipe line and a piece of equipment or an instrument to a pipe, tube or piece of equipment. A common connector is a flange. Joined fittings welded completely around the circumference of the interface are not considered connectors for the purpose of this part.

**Container glass** means glass made of soda-lime recipe, clear or colored, which is pressed and/or blown into bottles, jars, ampoules, and other products listed in North American Industry Classification System 327213 (NAICS 327213).

**Continuous bleed** means a continuous flow of pneumatic supply natural gas to the process control device (e.g. level control, temperature control, pressure control) where the supply gas pressure is modulated by the process condition, and then flows to the valve controller where the signal is compared with the process set-point to adjust gas pressure in the valve actuator.

**Continuous emission monitoring system or CEMS** means the total equipment required to sample, analyze, measure, and provide, by means of readings recorded at least once every 15 minutes, a permanent record of gas concentrations, pollutant emission rates, or gas volumetric flow rates from stationary sources.

**Continuous glass melting furnace** means a glass melting furnace that operates continuously except during periods of maintenance, malfunction, control device installation, reconstruction, or rebuilding.

**Conventional-Summer** refers to finished gasoline formulated for use in motor vehicles, the composition and properties of which do not meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under 40 CFR 80.40, but which meet summer RVP standards required under 40 CFR 80.27 or as specified by the state. NOTE: This category excludes conventional gasoline for oxygenate blending (CBOB) as well as other blendstock.

**Conventional-Winter** refers to finished gasoline formulated for use in motor vehicles, the composition and properties of which do not meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under 40 CFR 80.40 or the summer RVP standards required under 40 CFR 80.27 or as specified by the state. NOTE: This category excludes conventional blendstock for oxygenate blending (CBOB) as well as other blendstock.

**Crude oil** means a mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities.

(1) Depending upon the characteristics of the crude stream, it may also include any of the following:

- (i) Small amounts of hydrocarbons that exist in gaseous phase in natural underground reservoirs but are liquid at atmospheric conditions (temperature and pressure) after being recovered from oil well (casing-head) gas in lease separators and are subsequently commingled with the crude

stream without being separately measured. Lease condensate recovered as a liquid from natural gas wells in lease or field separation facilities and later mixed into the crude stream is also included.

- (ii) Small amounts of non-hydrocarbons, such as sulfur and various metals.
  - (iii) Drip gases, and liquid hydrocarbons produced from tar sands, oil sands, gilsonite, and oil shale.
  - (iv) Petroleum products that are received or produced at a refinery and subsequently injected into a crude supply or reservoir by the same refinery owner or operator.
- (2) Liquids produced at natural gas processing plants are excluded. Crude oil is refined to produce a wide array of petroleum products, including heating oils; gasoline, diesel and jet fuels; lubricants; asphalt; ethane, propane, and butane; and many other products used for their energy or chemical content.

**Cyclic**, in the context of fluorinated GHGs, means a fluorinated GHG in which three or more carbon atoms are connected to form a ring.

**Daily spread** means a manure management system component in which manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion.

**Day** means any consistently designated 24 hour period during which an emission unit is operated.

**Decarburization vessel** means any vessel used to further refine molten steel with the primary intent of reducing the carbon content of the steel, including but not limited to vessels used for argon-oxygen decarburization and vacuum oxygen decarburization.

**Deep bedding systems for cattle swine** means a manure management system in which, as manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture.

**Degasification system** means the entirety of the equipment that is used to drain gas from underground coal mines. This includes all degasification wells and gob gas vent holes at the underground coal mine. Degasification systems include gob and premine surface drainage wells, gob and premine in-mine drainage wells, and in-mine gob and premine cross-measure borehole wells.

**Degradable organic carbon (DOC)** means the fraction of the total mass of a waste material that can be biologically degraded.

**Dehydrator** means a device in which a liquid absorbent (including ethylene glycol, diethylene glycol, or triethylene glycol) or desiccant directly contacts a natural gas stream to remove water vapor.

**Dehydrator vent emissions** means natural gas and CO<sub>2</sub> released from a natural gas dehydrator system absorbent (typically glycol) regenerator still vent and, if present, a flash tank separator, to the atmosphere, flare, regenerator fire-box/fire tubes, or vapor recovery system. Emissions include stripping natural gas and motive natural gas used in absorbent circulation pumps.

**Delayed coking unit** means one or more refinery process units in which high molecular weight petroleum derivatives are thermally cracked and petroleum coke is produced in a series of closed, batch system reactors. A *delayed coking unit* consists of the coke drums and ancillary equipment associated with a single fractionator.

**De-methanizer** means the natural gas processing unit that separates methane rich residue gas from the heavier hydrocarbons (e.g., ethane, propane, butane, pentane-plus) in feed natural gas stream.

**Density** means the mass contained in a given unit volume (mass/volume).

**Desiccant** means a material used in solid-bed dehydrators to remove water from raw natural gas by adsorption or absorption. Desiccants include, but are not limited to, molecular sieves, activated alumina, pelletized calcium chloride, lithium chloride and granular silica gel material. Wet natural gas is passed through a bed of the granular or pelletized solid adsorbent or absorbent in these dehydrators. As the wet gas contacts the surface of the particles of desiccant material, water is adsorbed on the surface or absorbed and dissolves the surface of these desiccant particles. Passing through the entire desiccant bed, almost all of the water is adsorbed onto or absorbed into the desiccant material, leaving the dry gas to exit the contactor.

**Destruction** means:

- (1) With respect to landfills and manure management, the combustion of methane in any on-site or off-site combustion technology. Destroyed methane includes, but is not limited to, methane combusted by flaring, methane destroyed by thermal oxidation, methane combusted for use in on-site energy or heat production technologies, methane that is conveyed through pipelines (including natural gas pipelines) for off-site combustion, and methane that is collected for any other on-site or off-site use as a fuel.
- (2) With respect to fluorinated GHGs, the expiration of a fluorinated GHG to the destruction efficiency actually achieved. Such destruction does not result in a commercially useful end product.

**Destruction device** , for the purposes of subparts II and TT of this part, means a flare, thermal oxidizer, boiler, turbine, internal combustion engine, or any other combustion unit used to destroy or oxidize methane contained in landfill gas or wastewater biogas.

**Destruction efficiency** means the efficiency with which a destruction device reduces the mass of a greenhouse gas fed into the device. Destruction efficiency, or flaring destruction efficiency, refers to the fraction of the gas that leaves the flare partially or fully oxidized. The destruction efficiency is expressed in Equation A-2 of this section:

$$DE = 1 - \frac{tGHG_{iOUT}}{tGHG_{iIN}} \quad (\text{Eq. A-2})$$

where:

DE = Destruction Efficiency

tGHG<sub>iIN</sub> = The mass of GHG i fed into the destruction device

tGHG<sub>iOUT</sub> = The mass of GHG i exhausted from the destruction device

**Diesel–Other** is any distillate fuel oil not defined elsewhere, including Diesel Treated as Blendstock (DTAB).

**DIPE** (diisopropyl ether, (CH<sub>3</sub>)<sub>2</sub>CHOCH(CH<sub>3</sub>)<sub>2</sub>) is an ether as described in “Oxygenates.”

**Direct air capture (DAC)**, with respect to a facility, technology, or system, means that the facility, technology, or system uses carbon capture equipment to capture carbon dioxide directly from the air. Direct air capture does not include any facility, technology, or system that captures carbon dioxide:

- (1) That is deliberately released from a naturally occurring subsurface spring; or
- (2) Using natural photosynthesis.

**Direct liquefaction** means the conversion of coal directly into liquids, rather than passing through an intermediate gaseous state.

**Direct reduction furnace** means a high temperature furnace typically fired with natural gas to produce solid iron from iron ore or iron ore pellets and coke, coal, or other carbonaceous materials.

**Distillate fuel oil** means a classification for one of the petroleum fractions produced in conventional distillation operations and from crackers and hydrotreating process units. The generic term distillate fuel oil includes kerosene, kerosene-type jet fuel, diesel fuels (Diesel Fuels No. 1, No. 2, and No. 4), and fuel oils (Fuel Oils No. 1, No. 2, and No. 4).

**Distillate Fuel No. 1** has a maximum distillation temperature of 550 °F at the 90 percent recovery point and a minimum flash point of 100 °F and includes fuels commonly known as Diesel Fuel No. 1 and Fuel Oil No. 1, but excludes kerosene. This fuel is further subdivided into categories of sulfur content: High Sulfur (greater than 500 ppm), Low Sulfur (less than or equal to 500 ppm and greater than 15 ppm), and Ultra Low Sulfur (less than or equal to 15 ppm).

**Distillate Fuel No. 2** has a minimum and maximum distillation temperature of 540 °F and 640 °F at the 90 percent recovery point, respectively, and includes fuels commonly known as Diesel Fuel No. 2 and Fuel Oil No. 2. This fuel is further subdivided into categories of sulfur content: High Sulfur (greater than 500 ppm), Low Sulfur (less than or equal to 500 ppm and greater than 15 ppm), and Ultra Low Sulfur (less than or equal to 15 ppm).

**Distillate Fuel No. 4** is a distillate fuel oil made by blending distillate fuel oil and residual fuel oil, with a minimum flash point of 131 °F.

**DOC<sub>f</sub>** means the fraction of DOC that actually decomposes under the (presumably anaerobic) conditions within the landfill.

**Dry lot** means a manure management system component consisting of a paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically.

**Electric arc furnace (EAF)** means a furnace that produces molten alloy metal and heats the charge materials with electric arcs from carbon electrodes.

**Electric arc furnace steelmaking** means the production of carbon, alloy, or specialty steels using an EAF. This definition excludes EAFs at steel foundries and EAFs used to produce nonferrous metals.

**Electrothermic furnace** means a furnace that heats the charged materials with electric arcs from carbon electrodes.

**Emergency generator** means a stationary combustion device, such as a reciprocating internal combustion engine or turbine that serves solely as a secondary source of mechanical or electrical power whenever the primary energy supply is disrupted or discontinued during power outages or natural disasters that are beyond the control of the owner or operator of a facility. An emergency generator operates only during emergency situations, for training of personnel under simulated emergency conditions, as part of

emergency demand response procedures, or for standard performance testing procedures as required by law or by the generator manufacturer. A generator that serves as a back-up power source under conditions of load shedding, peak shaving, power interruptions pursuant to an interruptible power service agreement, or scheduled facility maintenance shall not be considered an emergency generator.

**Emergency equipment** means any auxiliary fossil fuel-powered equipment, such as a fire pump, that is used only in emergency situations.

**ETBE** (ethyl tertiary butyl ether,  $(\text{CH}_3)_3\text{COC}_2\text{H}$ ) is an ether as described in "Oxygenates."

**Ethane** is a paraffinic hydrocarbon with molecular formula  $\text{C}_2\text{H}_6$ .

**Ethanol** is an anhydrous alcohol with molecular formula  $\text{C}_2\text{H}_5\text{OH}$ .

**Ethylene** is an olefinic hydrocarbon with molecular formula  $\text{C}_2\text{H}_4$ .

**Ex refinery gate** means the point at which a petroleum product leaves the refinery.

**Experimental furnace** means a glass melting furnace with the sole purpose of operating to evaluate glass melting processes, technologies, or glass products. An experimental furnace does not produce glass that is sold (except for further research and development purposes) or that is used as a raw material for non-experimental furnaces.

**Export** means to transport a product from inside the United States to persons outside the United States, excluding any such transport on behalf of the United States military including foreign military sales under the Arms Export Control Act.

**Exporter** means any person, company or organization of record that transfers for sale or for other benefit, domestic products from the United States to another country or to an affiliate in another country, excluding any such transfers on behalf of the United States military or military purposes including foreign military sales under the Arms Export Control Act. An exporter is not the entity merely transporting the domestic products, rather an exporter is the entity deriving the principal benefit from the transaction.

**Facility** means any physical property, plant, building, structure, source, or stationary equipment located on one or more contiguous or adjacent properties in actual physical contact or separated solely by a public roadway or other public right-of-way and under common ownership or common control, that emits or may emit any greenhouse gas. Operators of military installations may classify such installations as more than a single facility based on distinct and independent functional groupings within contiguous military properties.

**Feed** means the prepared and mixed materials, which include but are not limited to materials such as limestone, clay, shale, sand, iron ore, mill scale, cement kiln dust and flyash, that are fed to the kiln. Feed does not include the fuels used in the kiln to produce heat to form the clinker product.

**Feedstock** means raw material inputs to a process that are transformed by reaction, oxidation, or other chemical or physical methods into products and by-products. Supplemental fuel burned to provide heat or thermal energy is not a feedstock.

**Fischer-Tropsch process** means a catalyzed chemical reaction in which synthesis gas, a mixture of carbon monoxide and hydrogen, is converted into liquid hydrocarbons of various forms.

**Flare** means a combustion device, whether at ground level or elevated, that uses an open flame to burn combustible gases with combustion air provided by uncontrolled ambient air around the flame.

**Flat glass** means glass made of soda-lime recipe and produced into continuous flat sheets and other products listed in NAICS 327211.



**Flowmeter** means a device that measures the mass or volumetric rate of flow of a gas, liquid, or solid moving through an open or closed conduit (e.g. flowmeters include, but are not limited to, rotameters, turbine meters, coriolis meters, orifice meters, ultra-sonic flowmeters, and vortex flowmeters).

**Fluid coking unit** means one or more refinery process units in which high molecular weight petroleum derivatives are thermally cracked and petroleum coke is continuously produced in a fluidized bed system. The fluid coking unit includes equipment for controlling air pollutant emissions and for heat recovery on the fluid coking burner exhaust vent. There are two basic types of fluid coking units: A traditional fluid coking unit in which only a small portion of the coke produced in the unit is burned to fuel the unit and the fluid coking burner exhaust vent is directed to the atmosphere (after processing in a CO boiler or other air pollutant control equipment) and a flexicoking unit in which an auxiliary burner is used to partially combust a significant portion of the produced petroleum coke to generate a low value fuel gas that is used as fuel in other combustion sources at the refinery.

**Fluorinated acetates** means fluorinated GHGs that are composed of an acetate group with one or more valence locations on the methyl group of the acetate occupied by fluorine atoms (e.g.,  $\text{CFH}_2\text{C}(\text{O})\text{O}-$ ,  $\text{CF}_2\text{HC}(\text{O})\text{O}-$ ) and, linked to the single-bonded oxygen of the acetate group, another hydrocarbon group in which one or more of the hydrogen atoms may be replaced by fluorine atoms.

**Fluorinated alcohols other than fluorotelomer alcohols** means fluorinated GHGs that include an alcohol functional group ( $-\text{OH}$ ) and that do not meet the definition of fluorotelomer alcohols.

**Fluorinated formates** means fluorinated GHGs that are composed of a formate group  $-\text{OCH}(\text{O})$  (carbonyl group with a single-bonded oxygen, and with a hydrogen atom) that is linked on the single-bonded oxygen atom to a hydrocarbon group in which one or more of the hydrogen atoms in the hydrocarbon group is replaced by fluorine atoms; the typical formula for fluorinated formates is  $\text{F}_n\text{ROCH}(\text{O})$ .

**Fluorinated greenhouse gas (GHG)** means sulfur hexafluoride ( $\text{SF}_6$ ), nitrogen trifluoride ( $\text{NF}_3$ ), and any fluorocarbon except for controlled substances as defined at part 82, subpart A of this subchapter and substances with vapor pressures of less than 1 mm of Hg absolute at 25 degrees C. With these exceptions, "fluorinated GHG" includes but is not limited to any hydrofluorocarbon, any perfluorocarbon, any fully fluorinated linear, branched or cyclic alkane, ether, tertiary amine or aminoether, any perfluoropolyether, and any hydrofluoropolyether.

**Fluorinated greenhouse gas (GHG) group** means one of the following sets of fluorinated GHGs:

- (1) Fully fluorinated GHGs;
- (2) Saturated hydrofluorocarbons with two or fewer carbon-hydrogen bonds;
- (3) Saturated hydrofluorocarbons with three or more carbon-hydrogen bonds;
- (4) Saturated hydrofluoroethers and hydrochlorofluoroethers with one carbon-hydrogen bond;
- (5) Saturated hydrofluoroethers and hydrochlorofluoroethers with two carbon-hydrogen bonds;
- (6) Saturated hydrofluoroethers and hydrochlorofluoroethers with three or more carbon-hydrogen bonds;
- (7) Saturated chlorofluorocarbons (CFCs);
- (8) Fluorinated formates;

- (9) Cyclic forms of the following: unsaturated perfluorocarbons (PFCs), unsaturated HFCs, unsaturated CFCs, unsaturated hydrochlorofluorocarbons (HCFCs), unsaturated bromofluorocarbons (BFCs), unsaturated bromochlorofluorocarbons (BCFCs), unsaturated hydrobromofluorocarbons (HBFCs), unsaturated hydrobromochlorofluorocarbons (HBCFCs), unsaturated halogenated ethers, and unsaturated halogenated esters;
- (10) Fluorinated acetates, carbonofluoridates, and fluorinated alcohols other than fluorotelomer alcohols;
- (11) Fluorinated aldehydes, fluorinated ketones and non-cyclic forms of the following: unsaturated PFCs, unsaturated HFCs, unsaturated CFCs, unsaturated HCFCs, unsaturated BFCs, unsaturated BCFCs, unsaturated HBFCs, unsaturated HBCFCs, unsaturated halogenated ethers, and unsaturated halogenated esters;
- (12) Fluorotelomer alcohols;
- (13) Fluorinated GHGs with carbon-iodine bonds; or
- (14) Remaining fluorinated GHGs.

**Fluorinated heat transfer fluids** means fluorinated GHGs used for temperature control, device testing, cleaning substrate surfaces and other parts, other solvent applications, and soldering in certain types of electronics manufacturing production processes and in other industries. Fluorinated heat transfer fluids do not include fluorinated GHGs used as lubricants or surfactants in electronics manufacturing. For fluorinated heat transfer fluids, the lower vapor pressure limit of 1 mm Hg in absolute at 25 °C in the definition of "fluorinated greenhouse gas" in this section shall not apply. Fluorinated heat transfer fluids include, but are not limited to, perfluoropolyethers (including PPFMIE), perfluoroalkylamines, perfluoroalkylmorpholines, perfluoroalkanes, perfluoroethers, perfluorocyclic ethers, and hydrofluoroethers. Fluorinated heat transfer fluids include HFC-43-10mee but do not include other hydrofluorocarbons.

**Fluorotelomer alcohols** means fluorinated GHGs with the chemical formula  $C_nF_{2n+1}CH_2CH_2OH$ .

**Fossil fuel** means natural gas, petroleum, coal, or any form of solid, liquid, or gaseous fuel derived from such material, for purpose of creating useful heat.

**Fractionators** means plants that produce fractionated natural gas liquids (NGLs) extracted from produced natural gas and separate the NGLs individual component products: ethane, propane, butanes and pentane-plus (C5 + ). Plants that only process natural gas but do not fractionate NGLs further into component products are not considered fractionators. Some fractionators do not process production gas, but instead fractionate bulk NGLs received from natural gas processors. Some fractionators both process natural gas and fractionate bulk NGLs received from other plants.

**Fuel** means solid, liquid or gaseous combustible material.

**Fuel gas** means gas generated at a petroleum refinery or petrochemical plant and that is combusted separately or in any combination with any type of gas.

**Fuel gas system** means a system of compressors, piping, knock-out pots, mix drums, and, if necessary, units used to remove sulfur contaminants from the fuel gas (e.g., amine scrubbers) that collects fuel gas from one or more sources for treatment, as necessary, and transport to a stationary combustion unit. A fuel gas system may have an overpressure vent to a flare but the primary purpose for a fuel gas system is to provide fuel to the various combustion units at the refinery or petrochemical plant.

**Fully fluorinated GHGs** means fluorinated GHGs that contain only single bonds and in which all available valence locations are filled by fluorine atoms. This includes but is not limited to: Saturated perfluorocarbons; SF<sub>6</sub>; NF<sub>3</sub>; SF<sub>5</sub>CF<sub>3</sub>; fully fluorinated linear, branched, and cyclic alkanes; fully fluorinated ethers; fully fluorinated tertiary amines; fully fluorinated aminoethers; and perfluoropolyethers.

**Furnace slag** means a by-product formed in metal melting furnaces when slagging agents, reducing agents, and/or fluxes (e.g., coke ash, limestone, silicates) are added to remove impurities from the molten metal.

**Gas collection system or landfill gas collection system** means a system of pipes used to collect landfill gas from different locations in the landfill by means of a fan or similar mechanical draft equipment (forced convection) to a single location for treatment (thermal destruction) or use. Landfill gas collection systems may also include knock-out or separator drums and/or a compressor. A single landfill may have multiple gas collection systems. Landfill gas collection systems do not include “passive” systems, whereby landfill gas flows naturally (without forced convection) to the surface of the landfill where an opening or pipe (vent) is installed to allow for the flow of landfill gas to the atmosphere or to a remote flare installed to combust landfill gas that is passively emitted from the vent. Landfill gas collection systems also do not include “active venting” systems, whereby landfill gas is conveyed to the surface of the landfill using forced convection, but the landfill gas is never recovered or thermally destroyed prior to release to the atmosphere.

**Gas conditions** mean the actual temperature, volume, and pressure of a gas sample.

**Gas-fired unit** means a stationary combustion unit that derives more than 50 percent of its annual heat input from the combustion of gaseous fuels, and the remainder of its annual heat input from the combustion of fuel oil or other liquid fuels.

**Gas monitor** means an instrument that continuously measures the concentration of a particular gaseous species in the effluent of a stationary source.

**Gas to oil ratio (GOR)** means the ratio of the volume of gas at standard temperature and pressure that is produced from a volume of oil when depressurized to standard temperature and pressure.

**Gaseous fuel** means a material that is in the gaseous state at standard atmospheric temperature and pressure conditions and that is combusted to produce heat and/or energy.

**Gasification** means the conversion of a solid or liquid raw material into a gas.

**Gasoline—Other** is any gasoline that is not defined elsewhere, including GTAB (gasoline treated as blendstock).

**Glass melting furnace** means a unit comprising a refractory-lined vessel in which raw materials are charged and melted at high temperature to produce molten glass.

**Glass produced** means the weight of glass exiting a glass melting furnace.

**Global warming potential or GWP** means the ratio of the time-integrated radiative forcing from the instantaneous release of one kilogram of a trace substance relative to that of one kilogram of a reference gas (i.e., CO<sub>2</sub>). GWPs for each greenhouse gas are provided in Table A-1 of this subpart. For purposes of the calculations in this part, if the GHG has a chemical-specific GWP listed in Table A-1, use that GWP. Otherwise, use the default GWP provided in Table A-1 for the fluorinated GHG group of which the GHG is a member.

**GPA** means the Gas Processors Association.

**Greenhouse gas or GHG** means carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and fluorinated greenhouse gases (GHGs) as defined in this section.

**GTBA** (gasoline-grade tertiary butyl alcohol,  $(\text{CH}_3)_3\text{COH}$ ), or t-butanol, is an alcohol as described in "Oxygenates."

**Heavy Gas Oils** are petroleum distillates with an approximate boiling range from 651 °F to 1,000 °F.

**Heel** means the amount of gas that remains in a shipping container after it is discharged or off-loaded (that is no more than ten percent of the volume of the container).

**High-bleed pneumatic devices** are automated, continuous bleed flow control devices powered by pressurized natural gas and used for maintaining a process condition such as liquid level, pressure, delta-pressure and temperature. Part of the gas power stream that is regulated by the process condition flows to a valve actuator controller where it vents continuously (bleeds) to the atmosphere at a rate in excess of 6 standard cubic feet per hour.

**High heat value or HHV** means the high or gross heat content of the fuel with the heat of vaporization included. The water is assumed to be in a liquid state.

**Hydrofluorocarbons or HFCs** means a class of GHGs consisting of hydrogen, fluorine, and carbon.

**Import** means, to land on, bring into, or introduce into, any place subject to the jurisdiction of the United States whether or not such landing, bringing, or introduction constitutes an importation within the meaning of the customs laws of the United States, with the following exemptions:

- (1) Off-loading used or excess fluorinated GHGs or nitrous oxide of U.S. origin from a ship during servicing.
- (2) Bringing fluorinated GHGs or nitrous oxide into the U.S. from Mexico where the fluorinated GHGs or nitrous oxide had been admitted into Mexico in bond and were of U.S. origin.
- (3) Bringing fluorinated GHGs or nitrous oxide into the U.S. when transported in a consignment of personal or household effects or in a similar non-commercial situation normally exempted from U.S. Customs attention.
- (4) Bringing fluorinated GHGs or nitrous into U.S. jurisdiction exclusively for U. S. military purposes.

**Importer** means any person, company, or organization of record that for any reason brings a product into the United States from a foreign country, excluding introduction into U.S. jurisdiction exclusively for United States military purposes. An importer is the person, company, or organization primarily liable for the payment of any duties on the merchandise or an authorized agent acting on their behalf. The term includes, as appropriate:

- (1) The consignee.
- (2) The importer of record.
- (3) The actual owner.
- (4) The transferee, if the right to draw merchandise in a bonded warehouse has been transferred.

**Indurating furnace** means a furnace where unfired taconite pellets, called green balls, are hardened at high temperatures to produce fired pellets for use in a blast furnace. Types of indurating furnaces include straight gate and grate kiln furnaces.

**Industrial greenhouse gases** means nitrous oxide or any fluorinated greenhouse gas.

**In-line kiln/raw mill** means a system in a portland cement production process where a dry kiln system is integrated with the raw mill so that all or a portion of the kiln exhaust gases are used to perform the drying operation of the raw mill, with no auxiliary heat source used. In this system the kiln is capable of operating without the raw mill operating, but the raw mill cannot operate without the kiln gases, and consequently, the raw mill does not generate a separate exhaust gas stream.

**Intermittent bleed pneumatic devices** mean automated flow control devices powered by pressurized natural gas and used for automatically maintaining a process condition such as liquid level, pressure, delta-pressure and temperature. These are snap-acting or throttling devices that discharge all or a portion of the full volume of the actuator intermittently when control action is necessary, but does not bleed continuously.

**Isobutane** is a paraffinic branch chain hydrocarbon with molecular formula  $C_4H_{10}$ .

**Isobutylene** is an olefinic branch chain hydrocarbon with molecular formula  $C_4H_8$ .

**Kerosene** is a light petroleum distillate with a maximum distillation temperature of 400 °F at the 10-percent recovery point, a final maximum boiling point of 572 °F, a minimum flash point of 100 °F, and a maximum freezing point of -22 °F. Included are No. 1-K and No. 2-K, distinguished by maximum sulfur content (0.04 and 0.30 percent of total mass, respectively), as well as all other grades of kerosene called range or stove oil. Excluded is kerosene-type jet fuel (see definition herein).

**Kerosene-type jet fuel** means a kerosene-based product used in commercial and military turbojet and turboprop aircraft. The product has a maximum distillation temperature of 400 °F at the 10 percent recovery point and a final maximum boiling point of 572 °F. Included are Jet A, Jet A-1, JP-5, and JP-8.

**Kiln** means an oven, furnace, or heated enclosure used for thermally processing a mineral or mineral-based substance.

**Landfill** means an area of land or an excavation in which wastes are placed for permanent disposal and that is not a land application unit, surface impoundment, injection well, or waste pile as those terms are defined under 40 CFR 257.2.

**Landfill gas** means gas produced as a result of anaerobic decomposition of waste materials in the landfill. Landfill gas generally contains 40 to 60 percent methane on a dry basis, typically less than 1 percent non-methane organic chemicals, and the remainder being carbon dioxide.

**Liberated** means released from coal and surrounding rock strata during the mining process. This includes both methane emitted from the ventilation system and methane drained from degasification systems.

**Lime** is the generic term for a variety of chemical compounds that are produced by the calcination of limestone or dolomite. These products include but are not limited to calcium oxide, high-calcium quicklime, calcium hydroxide, hydrated lime, dolomitic quicklime, and dolomitic hydrate.

**Liquid/Slurry** means a manure management component in which manure is stored as excreted or with some minimal addition of water to facilitate handling and is stored in either tanks or earthen ponds, usually for periods less than one year.

**Low-bleed pneumatic devices** mean automated flow control devices powered by pressurized natural gas and used for maintaining a process condition such as liquid level, pressure, delta-pressure and temperature. Part of the gas power stream that is regulated by the process condition flows to a valve actuator controller where it vents continuously (bleeds) to the atmosphere at a rate equal to or less than six standard cubic feet per hour.

**Lubricants** include all grades of lubricating oils, from spindle oil to cylinder oil to those used in greases. Petroleum lubricants may be produced from distillates or residues.

**Makeup chemicals** means carbonate chemicals (e.g., sodium and calcium carbonates) that are added to the chemical recovery areas of chemical pulp mills to replace chemicals lost in the process.

**Manure composting** means the biological oxidation of a solid waste including manure usually with bedding or another organic carbon source typically at thermophilic temperatures produced by microbial heat production. There are four types of composting employed for manure management: Static, in vessel, intensive windrow and passive windrow. Static composting typically occurs in an enclosed channel, with forced aeration and continuous mixing. In vessel composting occurs in piles with forced aeration but no mixing. Intensive windrow composting occurs in windrows with regular turning for mixing and aeration. Passive windrow composting occurs in windrows with infrequent turning for mixing and aeration.

**Maximum rated heat input capacity** means the hourly heat input to a unit (in mmBtu/hr), when it combusts the maximum amount of fuel per hour that it is capable of combusting on a steady state basis, as of the initial installation of the unit, as specified by the manufacturer.

**Maximum rated input capacity** means the maximum charging rate of a municipal waste combustor unit expressed in tons per day of municipal solid waste combusted, calculated according to the procedures under 40 CFR 60.58b(j).

**Mcf** means thousand cubic feet.

**Methane conversion factor** means the extent to which the CH<sub>4</sub> producing capacity (B<sub>0</sub>) is realized in each type of treatment and discharge pathway and system. Thus, it is an indication of the degree to which the system is anaerobic.

**Methane correction factor** means an adjustment factor applied to the methane generation rate to account for portions of the landfill that remain aerobic. The methane correction factor can be considered the fraction of the total landfill waste volume that is ultimately disposed of in an anaerobic state. Managed landfills that have soil or other cover materials have a methane correction factor of 1.

**Methanol** (CH<sub>3</sub>OH) is an alcohol as described in "Oxygenates."

**Midgrade gasoline** has an octane rating greater than or equal to 88 and less than or equal to 90. This definition applies to the midgrade categories of Conventional-Summer, Conventional-Winter, Reformulated-Summer, and Reformulated-Winter. For midgrade categories of RBOB-Summer, RBOB-Winter, CBOB-Summer, and CBOB-Winter, this definition refers to the expected octane rating of the finished gasoline after oxygenate has been added to the RBOB or CBOB.

**Miscellaneous products** include all refined petroleum products not defined elsewhere. It includes, but is not limited to, naphtha-type jet fuel (Jet B and JP-4), petrolatum lube refining by-products (aromatic extracts and tars), absorption oils, ram-jet fuel, petroleum rocket fuels, synthetic natural gas feedstocks, waste feedstocks, and specialty oils. It excludes organic waste sludges, tank bottoms, spent catalysts, and sulfuric acid.

**MMBtu** means million British thermal units.

**Motor gasoline (finished)** means a complex mixture of volatile hydrocarbons, with or without additives, suitably blended to be used in spark ignition engines. Motor gasoline includes conventional gasoline, reformulated gasoline, and all types of oxygenated gasoline. Gasoline also has seasonal variations in an effort to

control ozone levels. This is achieved by lowering the Reid Vapor Pressure (RVP) of gasoline during the summer driving season. Depending on the region of the country the RVP is lowered to below 9.0 psi or 7.8 psi. The RVP may be further lowered by state regulations.

**Mscf** means thousand standard cubic feet.

**MTBE** (methyl tertiary butyl ether,  $(\text{CH}_3)_3\text{COCH}_3$ ) is an ether as described in "Oxygenates."

**Municipal solid waste landfill or MSW landfill** means an entire disposal facility in a contiguous geographical space where household waste is placed in or on land. An MSW landfill may also receive other types of RCRA Subtitle D wastes (40 CFR 257.2) such as commercial solid waste, nonhazardous sludge, conditionally exempt small quantity generator waste, and industrial solid waste. Portions of an MSW landfill may be separated by access roads, public roadways, or other public right-of-ways. An MSW landfill may be publicly or privately owned.

**Municipal solid waste or MSW** means solid phase household, commercial/retail, and/or institutional waste. Household waste includes material discarded by single and multiple residential dwellings, hotels, motels, and other similar permanent or temporary housing establishments or facilities. Commercial/retail waste includes material discarded by stores, offices, restaurants, warehouses, non-manufacturing activities at industrial facilities, and other similar establishments or facilities. Institutional waste includes material discarded by schools, nonmedical waste discarded by hospitals, material discarded by non-manufacturing activities at prisons and government facilities, and material discarded by other similar establishments or facilities. Household, commercial/retail, and institutional wastes include yard waste, refuse-derived fuel, and motor vehicle maintenance materials. Insofar as there is separate collection, processing and disposal of industrial source waste streams consisting of used oil, wood pallets, construction, renovation, and demolition wastes (which includes, but is not limited to, railroad ties and telephone poles), paper, clean wood, plastics, industrial process or manufacturing wastes, medical waste, motor vehicle parts or vehicle fluff, or used tires that do not contain hazardous waste identified or listed under 42 U.S.C. § 6921, such wastes are not municipal solid waste. However, such wastes qualify as municipal solid waste where they are collected with other municipal solid waste or are otherwise combined with other municipal solid waste for processing and/or disposal.

**Municipal wastewater treatment plant** means a series of treatment processes used to remove contaminants and pollutants from domestic, business, and industrial wastewater collected in city sewers and transported to a centralized wastewater treatment system such as a publicly owned treatment works (POTW).

**N<sub>2</sub>O** means nitrous oxide.

**Naphthas (<401 °F)** is a generic term applied to a petroleum fraction with an approximate boiling range between 122 °F and 400 °F. The naphtha fraction of crude oil is the raw material for gasoline and is composed largely of paraffinic hydrocarbons.

**Natural gas** means a naturally occurring mixture of hydrocarbon and non-hydrocarbon gases found in geologic formations beneath the earth's surface, of which the principal constituent is methane. Natural gas may be field quality or pipeline quality.

**Natural gas driven pneumatic pump** means a pump that uses pressurized natural gas to move a piston or diaphragm, which pumps liquids on the opposite side of the piston or diaphragm.

**Natural gas liquids (NGLs)** means those hydrocarbons in natural gas that are separated from the gas as liquids through the process of absorption, condensation, adsorption, or other methods. Generally, such liquids consist of ethane, propane, butanes, and pentanes plus. Bulk NGLs refers to mixtures of NGLs that are sold or delivered as undifferentiated product from natural gas processing plants.

**Natural gasoline** means a mixture of liquid hydrocarbons (mostly pentanes and heavier hydrocarbons) extracted from natural gas. It includes isopentane.

**NIST** means the United States National Institute of Standards and Technology.

**Nitric acid production line** means a series of reactors and absorbers used to produce nitric acid.

**Nitrogen excreted** is the nitrogen that is excreted by livestock in manure and urine.

**Non-crude feedstocks** means any petroleum product or natural gas liquid that enters the refinery to be further refined or otherwise used on site.

**Non-recovery coke oven battery** means a group of ovens connected by common walls and operated as a unit, where coal undergoes destructive distillation under negative pressure to produce coke, and which is designed for the combustion of the coke oven gas from which by-products are not recovered.

**North American Industry Classification System (NAICS) code(s)** means the six-digit code(s) that represents the product(s)/activity(s)/service(s) at a facility or supplier as listed in the FEDERAL REGISTER and defined in “North American Industrial Classification System Manual 2007,” available from the U.S. Department of Commerce, National Technical Information Service, Alexandria, VA 22312, phone (703) 605-6000 or (800) 553-6847. <http://www.census.gov/eos/www/naics/>.

**Oil-fired unit** means a stationary combustion unit that derives more than 50 percent of its annual heat input from the combustion of fuel oil, and the remainder of its annual heat input from the combustion of natural gas or other gaseous fuels.

**Open-ended valve or lines (OELs)** means any valve, except pressure relief valves, having one side of the valve seat in contact with process fluid and one side open to atmosphere, either directly or through open piping.

**Operating hours** means the duration of time in which a process or process unit is utilized; this excludes shutdown, maintenance, and standby.

**Operational change** means, for purposes of § 98.3(b), a change in the type of feedstock or fuel used, a change in operating hours, or a change in process production rate.

**Operator** means any person who operates or supervises a facility or supplier.

**Other oils (>401 °F)** are oils with a boiling range equal to or greater than 401 °F that are generally intended for use as a petrochemical feedstock and are not defined elsewhere.

**Outer Continental Shelf** means all submerged lands lying seaward and outside of the area of lands beneath navigable waters as defined in 43 U.S.C. 1331, and of which the subsoil and seabed appertain to the United States and are subject to its jurisdiction and control.

**Owner** means any person who has legal or equitable title to, has a leasehold interest in, or control of a facility or supplier, except a person whose legal or equitable title to or leasehold interest in the facility or supplier arises solely because the person is a limited partner in a partnership that has legal or equitable title to, has a leasehold interest in, or control of the facility or supplier shall not be considered an “owner” of the facility or supplier.



**Oxygenates** means substances which, when added to gasoline, increase the oxygen content of the gasoline. Common oxygenates are ethanol, methyl tertiary butyl ether (MTBE), ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME), diisopropyl ether (DIPE), and methanol.

**Pasture/Range/Paddock** means the manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed.

**Pentanes plus**, or C5 +, is a mixture of hydrocarbons that is a liquid at ambient temperature and pressure, and consists mostly of pentanes (five carbon chain) and higher carbon number hydrocarbons. Pentanes plus includes, but is not limited to, normal pentane, isopentane, hexanes-plus (natural gasoline), and plant condensate.

**Perfluorocarbons or PFCs** means a class of greenhouse gases consisting on the molecular level of carbon and fluorine.

**Petrochemical** means methanol, acrylonitrile, ethylene, ethylene oxide, ethylene dichloride, and any form of carbon black.

**Petrochemical feedstocks** means feedstocks derived from petroleum for the manufacture of chemicals, synthetic rubber, and a variety of plastics. This category is usually divided into naphthas less than 401 °F and other oils greater than 401 °F.

**Petroleum** means oil removed from the earth and the oil derived from tar sands and shale.

**Petroleum coke** means a black solid residue, obtained mainly by cracking and carbonizing of petroleum derived feedstocks, vacuum bottoms, tar and pitches in processes such as delayed coking or fluid coking. It consists mainly of carbon (90 to 95 percent), has low ash content, and may be used as a feedstock in coke ovens. This product is also known as marketable coke or catalyst coke.

**Petroleum product** means all refined and semi-refined products that are produced at a refinery by processing crude oil and other petroleum-based feedstocks, including petroleum products derived from co-processing biomass and petroleum feedstock together, but not including plastics or plastic products. Petroleum products may be combusted for energy use, or they may be used either for non-energy processes or as non-energy products. The definition of petroleum product for importers and exporters excludes waxes.

**Physical address**, with respect to a United States parent company as defined in this section, means the street address, city, state and zip code of that company's physical location.

**Pit storage below animal confinement (deep pits)** means the collection and storage of manure typically below a slatted floor in an enclosed animal confinement facility. This usually occurs with little or no added water for periods less than one year.

**Plant code** means either of the following:

- (1) The Plant ID code assigned by the Department of Energy's Energy Information Administration. The Energy Information Administration Plant ID code is also referred to as the "ORIS code", "ORISPL code", "Facility ID", or "Facility code", among other names.
- (2) If a Plant ID code has not been assigned by the Department of Energy's Energy Information Administration, then plant code means a code beginning with "88" assigned by the EPA's Clean Air Markets Division for electronic reporting.

**Portable** means designed and capable of being carried or moved from one location to another. Indications of portability include but are not limited to wheels, skids, carrying handles, dolly, trailer, or platform. Equipment is not portable if any one of the following conditions exists:

- (1) The equipment is attached to a foundation.
- (2) The equipment or a replacement resides at the same location for more than 12 consecutive months.
- (3) The equipment is located at a seasonal facility and operates during the full annual operating period of the seasonal facility, remains at the facility for at least two years, and operates at that facility for at least three months each year.
- (4) The equipment is moved from one location to another in an attempt to circumvent the portable residence time requirements of this definition.

**Poultry manure with litter** means a manure management system component that is similar to cattle and swine deep bedding except usually not combined with a dry lot or pasture. The system is typically used for poultry breeder flocks and for the production of meat type chickens (broiler) and other fowl.

**Poultry manure without litter** means a manure management system component that may manage manure in a liquid form, similar to open pits in enclosed animal confinement facilities. These systems may alternatively be designed and operated to dry manure as it accumulates. The latter is known as a high-rise manure management system and is a form of passive windrow manure composting when designed and operated properly.

**Precision** of a measurement at a specified level (e.g., one percent of full scale or one percent of the value measured) means that 95 percent of repeat measurements made by a device or technique are within the range bounded by the mean of the measurements plus or minus the specified level.

**Premium grade gasoline** is gasoline having an antiknock index, i.e., octane rating, greater than 90. This definition applies to the premium grade categories of Conventional-Summer, Conventional-Winter, Reformulated-Summer, and Reformulated-Winter. For premium grade categories of RBOB-Summer, RBOB-Winter, CBOB-Summer, and CBOB-Winter, this definition refers to the expected octane rating of the finished gasoline after oxygenate has been added to the RBOB or CBOB.

**Pressed and blown glass** means glass which is pressed, blown, or both, into products such as light bulbs, glass fiber, technical glass, and other products listed in NAICS 327212.

**Pressure relief device or pressure relief valve or pressure safety valve** means a safety device used to prevent operating pressures from exceeding the maximum allowable working pressure of the process equipment. A common pressure relief device is but not limited to a spring-loaded pressure relief valve. Devices that are actuated either by a pressure of less than or equal to 2.5 psig or by a vacuum are not pressure relief devices.

**Primary fuel** means the fuel that provides the greatest percentage of the annual heat input to a stationary fuel combustion unit.

**Process emissions** means the emissions from industrial processes (e.g., cement production, ammonia production) involving chemical or physical transformations other than fuel combustion. For example, the calcination of carbonates in a kiln during cement production or the oxidation of methane in an ammonia process results in the release of process CO<sub>2</sub> emissions to the atmosphere. Emissions from fuel combustion to provide process heat are not part of process emissions, whether the combustion is internal or external to the process equipment.

**Process unit** means the equipment assembled and connected by pipes and ducts to process raw materials and to manufacture either a final product or an intermediate used in the onsite production of other products. The process unit also includes the purification of recovered byproducts.

**Process vent** means a gas stream that: Is discharged through a conveyance to the atmosphere either directly or after passing through a control device; originates from a unit operation, including but not limited to reactors (including reformers, crackers, and furnaces, and separation equipment for products and recovered byproducts); and contains or has the potential to contain GHG that is generated in the process. Process vent does not include safety device discharges, equipment leaks, gas streams routed to a fuel gas system or to a flare, discharges from storage tanks.

**Propane** is a paraffinic hydrocarbon with molecular formula  $C_3H_8$ .

**Propylene** is an olefinic hydrocarbon with molecular formula  $C_3H_6$ .

**Pulp mill lime kiln** means the combustion units (e.g., rotary lime kiln or fluidized bed calciner) used at a kraft or soda pulp mill to calcine lime mud, which consists primarily of calcium carbonate, into quicklime, which is calcium oxide.

**Pushing** means the process of removing the coke from the coke oven at the end of the coking cycle. Pushing begins when coke first begins to fall from the oven into the quench car and ends when the quench car enters the quench tower.

**Raw mill** means a ball and tube mill, vertical roller mill or other size reduction equipment, that is not part of an in-line kiln/raw mill, used to grind feed to the appropriate size. Moisture may be added or removed from the feed during the grinding operation. If the raw mill is used to remove moisture from feed materials, it is also, by definition, a raw material dryer. The raw mill also includes the air separator associated with the raw mill.

**RBOB-Summer** (reformulated blendstock for oxygenate blending) means a petroleum product which, when blended with a specified type and percentage of oxygenate, meets the definition of Reformulated-Summer.

**RBOB-Winter** (reformulated blendstock for oxygenate blending) means a petroleum product which, when blended with a specified type and percentage of oxygenate, meets the definition of Reformulated-Winter.

**Reciprocating compressor** means a piece of equipment that increases the pressure of a process natural gas or  $CO_2$  by positive displacement, employing linear movement of a shaft driving a piston in a cylinder.

**Reciprocating compressor rod packing** means a series of flexible rings in machined metal cups that fit around the reciprocating compressor piston rod to create a seal limiting the amount of compressed natural gas or  $CO_2$  that escapes to the atmosphere.

**Re-condenser** means heat exchangers that cool compressed boil-off gas to a temperature that will condense natural gas to a liquid.

**Reformulated-Summer** refers to finished gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under 40 CFR 80.40 and 40 CFR 80.41, and summer RVP standards required under 40 CFR 80.27 or as specified by the state. Reformulated gasoline excludes Reformulated Blendstock for Oxygenate Blending (RBOB) as well as other blendstock.

**Reformulated-Winter** refers to finished gasoline formulated for use in motor vehicles, the composition and properties of which meet the requirements of the reformulated gasoline regulations promulgated by the U.S. Environmental Protection Agency under 40 CFR 80.40 and 40 CFR 80.41, but which do not meet summer RVP standards required under 40 CFR 80.27 or as specified by the state. NOTE: This category includes Oxygenated Fuels Program Reformulated Gasoline (OPRG). Reformulated gasoline excludes Reformulated Blendstock for Oxygenate Blending (RBOB) as well as other blendstock.

**Regular grade gasoline** is gasoline having an antiknock index, i.e., octane rating, greater than or equal to 85 and less than 88. This definition applies to the regular grade categories of Conventional-Summer, Conventional-Winter, Reformulated-Summer, and Reformulated-Winter. For regular grade categories of RBOB-Summer, RBOB-Winter, CBOB-Summer, and CBOB-Winter, this definition refers to the expected octane rating of the finished gasoline after oxygenate has been added to the RBOB or CBOB.

**Remaining fluorinated GHGs** means fluorinated GHGs that are none of the following:

- (1) Fully fluorinated GHGs;
- (2) Saturated hydrofluorocarbons with two or fewer carbon-hydrogen bonds;
- (3) Saturated hydrofluorocarbons with three or more carbon-hydrogen bonds;
- (4) Saturated hydrofluoroethers and hydrochlorofluoroethers with one carbon-hydrogen bond;
- (5) Saturated hydrofluoroethers and hydrochlorofluoroethers with two carbon-hydrogen bonds;
- (6) Saturated hydrofluoroethers and hydrochlorofluoroethers with three or more carbon-hydrogen bonds;
- (7) Saturated chlorofluorocarbons (CFCs);
- (8) Fluorinated formates;
- (9) Cyclic forms of the following: unsaturated perfluorocarbons (PFCs), unsaturated HFCs, unsaturated CFCs, unsaturated hydrochlorofluorocarbons (HCFCs), unsaturated bromofluorocarbons (BFCs), unsaturated bromochlorofluorocarbons (BCFCs), unsaturated hydrobromofluorocarbons (HBFCs), unsaturated hydrobromochlorofluorocarbons (HBCFCs), unsaturated halogenated ethers, and unsaturated halogenated esters;
- (10) Fluorinated acetates, carbonofluoridates, and fluorinated alcohols other than fluorotelomer alcohols;
- (11) Fluorinated aldehydes, fluorinated ketones and non-cyclic forms of the following: unsaturated PFCs, unsaturated HFCs, unsaturated CFCs, unsaturated HCFCs, unsaturated BFCs, unsaturated BCFCs, unsaturated HBFCs, unsaturated HBCFCs, unsaturated halogenated ethers, and unsaturated halogenated esters;
- (12) Fluorotelomer alcohols; or
- (13) fluorinated GHGs with carbon-iodine bonds.

**Rendered animal fat**, or tallow, means fats extracted from animals which are generally used as a feedstock in making biodiesel.

**Reporting year** means the calendar year during which the GHG data are required to be collected for purposes of the annual GHG report. For example, reporting year 2014 is January 1, 2014 through December 31, 2014, and the annual report for reporting year 2014 is submitted to EPA on March 31, 2015.

**Research and development** means those activities conducted in process units or at laboratory bench-scale settings whose purpose is to conduct research and development for new processes, technologies, or products and whose purpose is not for the manufacture of products for commercial sale, except in a *de minimis* manner.

**Residual Fuel Oil No. 5 (Navy Special)** is a classification for the heavier fuel oil generally used in steam powered vessels in government service and inshore power plants. It has a minimum flash point of 131 °F.

**Residual Fuel Oil No. 6 (a.k.a. Bunker C)** is a classification for the heavier fuel oil generally used for the production of electric power, space heating, vessel bunkering and various industrial purposes. It has a minimum flash point of 140 °F.

**Residuum** is residue from crude oil after distilling off all but the heaviest components, with a boiling range greater than 1,000 °F.

**Road oil** is any heavy petroleum oil, including residual asphaltic oil used as a dust palliative and surface treatment on roads and highways. It is generally produced in six grades, from 0, the most liquid, to 5, the most viscous.

**Rotary lime kiln** means a unit with an inclined rotating drum that is used to produce a lime product from limestone by calcination.

**Safety device** means a closure device such as a pressure relief valve, frangible disc, fusible plug, or any other type of device which functions exclusively to prevent physical damage or permanent deformation to a unit or its air emission control equipment by venting gases or vapors directly to the atmosphere during unsafe conditions resulting from an unplanned, accidental, or emergency event. A safety device is not used for routine venting of gases or vapors from the vapor headspace underneath a cover such as during filling of the unit or to adjust the pressure in response to normal daily diurnal ambient temperature fluctuations. A safety device is designed to remain in a closed position during normal operations and open only when the internal pressure, or another relevant parameter, exceeds the device threshold setting applicable to the air emission control equipment as determined by the owner or operator based on manufacturer recommendations, applicable regulations, fire protection and prevention codes and practices, or other requirements for the safe handling of flammable, combustible, explosive, reactive, or hazardous materials.

**Sales oil** means produced crude oil or condensate measured at the production lease automatic custody transfer (LACT) meter or custody transfer tank gauge.

**Saturated chlorofluorocarbons (CFCs)** means fluorinated GHGs that contain only chlorine, fluorine, and carbon and that contain only single bonds.

**Saturated hydrochlorofluoroethers (HCFEs)** means fluorinated GHGs in which two hydrocarbon groups are linked by an oxygen atom; in which two or more, but not all, of the hydrogen atoms in the hydrocarbon groups have been replaced by fluorine atoms and chlorine atoms; and which contain only single bonds.

**Saturated hydrofluorocarbons (HFCs)** means fluorinated GHGs that are hydrofluorocarbons and that contain only single bonds.

**Saturated hydrofluoroethers (HFEs)** means fluorinated GHGs in which two hydrocarbon groups are linked by an oxygen atom; in which one or more, but not all, of the hydrogen atoms in the hydrocarbon groups have been replaced by fluorine atoms; and which contain only single bonds.

**Semi-refined petroleum product** means all oils requiring further processing. Included in this category are unfinished oils which are produced by the partial refining of crude oil and include the following: Naphthas and lighter oils; kerosene and light gas oils; heavy gas oils; and residuum, and all products that require further processing or the addition of blendstocks.

**Sendout** means, in the context of a local distribution company, the total deliveries of natural gas to customers over a specified time interval (typically hour, day, month, or year). Sendout is the sum of gas received through the city gate, gas withdrawn from on-system storage or peak shaving plants, and gas produced and delivered into the distribution system; and is net of any natural gas injected into on-system storage. It comprises gas sales, exchange, deliveries, gas used by company, and unaccounted for gas. Sendout is measured at the city gate station, and other on-system receipt points from storage, peak shaving, and production.

**Sensor** means a device that measures a physical quantity/quality or the change in a physical quantity/quality, such as temperature, pressure, flow rate, pH, or liquid level.

**SF<sub>6</sub>** means sulfur hexafluoride.

**Shutdown** means the cessation of operation of an emission source for any purpose.

**Silicon carbide** means an artificial abrasive produced from silica sand or quartz and petroleum coke.

**Sinter process** means a process that produces a fused aggregate of fine iron-bearing materials suited for use in a blast furnace. The sinter machine is composed of a continuous traveling grate that conveys a bed of ore fines and other finely divided iron-bearing material and fuel (typically coke breeze), a burner at the feed end of the grate for ignition, and a series of downdraft windboxes along the length of the strand to support downdraft combustion and heat sufficient to produce a fused sinter product.

**Site** means any combination of one or more graded pad sites, gravel pad sites, foundations, platforms, or the immediate physical location upon which equipment is physically located.

**Smelting furnace** means a furnace in which lead-bearing materials, carbon-containing reducing agents, and fluxes are melted together to form a molten mass of material containing lead and slag.

**Solid by-products** means plant matter such as vegetable waste, animal materials/wastes, and other solid biomass, except for wood, wood waste, and sulphite lyes (black liquor).

**Solid storage** is the storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.

**Sour gas** means any gas that contains significant concentrations of hydrogen sulfide. Sour gas may include untreated fuel gas, amine stripper off-gas, or sour water stripper gas.

**Sour natural gas** means natural gas that contains significant concentrations of hydrogen sulfide (H<sub>2</sub>S) and/or carbon dioxide (CO<sub>2</sub>) that exceed the concentrations specified for commercially saleable natural gas delivered from transmission and distribution pipelines.

**Special naphthas** means all finished products with the naphtha boiling range (290 ° to 470 °F) that are generally used as paint thinners, cleaners or solvents. These products are refined to a specified flash point. Special naphthas include all commercial hexane and cleaning solvents conforming to ASTM Specification D1836-07, Standard Specification for Commercial Hexanes, and D235-02 (Reapproved 2007), Standard

Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent), respectively. Naphthas to be blended or marketed as motor gasoline or aviation gasoline, or that are to be used as petrochemical and synthetic natural gas (SNG) feedstocks are excluded.

**Spent liquor solids** means the dry weight of the solids in the spent pulping liquor that enters the chemical recovery furnace or chemical recovery combustion unit.

**Spent pulping liquor** means the residual liquid collected from on-site pulping operations at chemical pulp facilities that is subsequently fired in chemical recovery furnaces at kraft and soda pulp facilities or chemical recovery combustion units at sulfite or semi-chemical pulp facilities.

**Standard conditions or standard temperature and pressure (STP)**, for the purposes of this part, means either 60 or 68 degrees Fahrenheit and 14.7 pounds per square inch absolute.

**Steam reforming** means a catalytic process that involves a reaction between natural gas or other light hydrocarbons and steam. The result is a mixture of hydrogen, carbon monoxide, carbon dioxide, and water.

**Still gas** means any form or mixture of gases produced in refineries by distillation, cracking, reforming, and other processes. The principal constituents are methane, ethane, ethylene, normal butane, butylene, propane, and propylene.

**Storage tank** means a vessel (excluding sumps) that is designed to contain an accumulation of crude oil, condensate, intermediate hydrocarbon liquids, or produced water and that is constructed entirely of non-earthen materials (e.g., wood, concrete, steel, plastic) that provide structural support.

**Sulfur recovery plant** means all process units which recover sulfur or produce sulfuric acid from hydrogen sulfide ( $H_2S$ ) and/or sulfur dioxide ( $SO_2$ ) from a common source of sour gas at a petroleum refinery. The sulfur recovery plant also includes sulfur pits used to store the recovered sulfur product, but it does not include secondary sulfur storage vessels or loading facilities downstream of the sulfur pits. For example, a Claus sulfur recovery plant includes: Reactor furnace and waste heat boiler, catalytic reactors, sulfur pits, and, if present, oxidation or reduction control systems, or incinerator, thermal oxidizer, or similar combustion device. Multiple sulfur recovery units are a single sulfur recovery plant only when the units share the same source of sour gas. Sulfur recovery units that receive source gas from completely segregated sour gas treatment systems are separate sulfur recovery plants.

**Supplemental fuel** means a fuel burned within a petrochemical process that is not produced within the process itself.

**Supplier** means a producer, importer, or exporter in any supply category included in Table A-5 to this subpart, as defined by the corresponding subpart of this part.

**Sweet gas** is natural gas with low concentrations of hydrogen sulfide ( $H_2S$ ) and/or carbon dioxide ( $CO_2$ ) that does not require (or has already had) acid gas treatment to meet pipeline corrosion-prevention specifications for transmission and distribution.

**Taconite iron ore processing** means an industrial process that separates and concentrates iron ore from taconite, a low grade iron ore, and heats the taconite in an indurating furnace to produce taconite pellets that are used as the primary feed material for the production of iron in blast furnaces at integrated iron and steel plants.

**TAME** means tertiary amyl methyl ether,  $(CH_3)_2(C_2H_5)COCH_3$ .

**Trace concentrations** means concentrations of less than 0.1 percent by mass of the process stream.

**Transform** means to use and entirely consume (except for trace concentrations) nitrous oxide or fluorinated GHGs in the manufacturing of other chemicals for commercial purposes. Transformation does not include burning of nitrous oxide.

**Transshipment** means the continuous shipment of nitrous oxide or a fluorinated GHG from a foreign state of origin through the United States or its territories to a second foreign state of final destination, as long as the shipment does not enter into United States jurisdiction. A transshipment, as it moves through the United States or its territories, cannot be re-packaged, sorted or otherwise changed in condition.

**Trona** means the raw material (mineral) used to manufacture soda ash; hydrated sodium bicarbonate carbonate (e.g.,  $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$ ).

**Ultimate analysis** means the determination of the percentages of carbon, hydrogen, nitrogen, sulfur, and chlorine and (by difference) oxygen in the gaseous products and ash after the complete combustion of a sample of an organic material.

**Unfinished oils** are all oils requiring further processing, except those requiring only mechanical blending.

**United States** means the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the Virgin Islands, Guam, and any other Commonwealth, territory or possession of the United States, as well as the territorial sea as defined by Presidential Proclamation No. 5928.

**United States parent company(s)** means the highest-level United States company(s) with an ownership interest in the facility or supplier as of December 31 of the year for which data are being reported.

**Unsaturated bromochlorofluoro-carbons (BCFCs)** means fluorinated GHGs that contain only bromine, chlorine, fluorine, and carbon and that contain one or more bonds that are not single bonds.

**Unsaturated bromofluorocarbons (BFCs)** means fluorinated GHGs that contain only bromine, fluorine, and carbon and that contain one or more bonds that are not single bonds.

**Unsaturated chlorofluorocarbons (CFCs)** means fluorinated GHGs that contain only chlorine, fluorine, and carbon and that contain one or more bonds that are not single bonds.

**Unsaturated halogenated ethers** means fluorinated GHGs in which two hydrocarbon groups are linked by an oxygen atom; in which one or more of the hydrogen atoms in the hydrocarbon groups have been replaced by fluorine atoms; and which contain one or more bonds that are not single bonds. Unsaturated ethers include unsaturated HFEs.

**Unsaturated hydrobromochloro-fluorocarbons (HBCFCs)** means fluorinated GHGs that contain only hydrogen, bromine, chlorine, fluorine, and carbon and that contain one or more bonds that are not single bonds.

**Unsaturated hydrobromofluoro-carbons (HBFCs)** means fluorinated GHGs that contain only hydrogen, bromine, fluorine, and carbon and that contain one or more bonds that are not single bonds.

**Unsaturated hydrochlorofluorocarbons (HCFCs)** means fluorinated GHGs that contain only carbon, chlorine, fluorine, and hydrogen and that contain one or more bonds that are not single bonds.

**Unsaturated hydrofluorocarbons (HFCs)** means fluorinated GHGs that are hydrofluorocarbons and that contain one or more bonds that are not single bonds.

**Unsaturated perfluorocarbons (PFCs)** means fluorinated GHGs that are perfluorocarbons and that contain one or more bonds that are not single bonds.



**Unstabilized crude oil** means, for the purposes of this part, crude oil that is pumped from the well to a pipeline or pressurized storage vessel for transport to the refinery without intermediate storage in a storage tank at atmospheric pressures. Unstabilized crude oil is characterized by having a true vapor pressure of 5 pounds per square inch absolute (psia) or greater.

**Used oil** means a petroleum-derived or synthetically-derived oil whose physical properties have changed as a result of handling or use, such that the oil cannot be used for its original purpose. Used oil consists primarily of automotive oils (e.g., used motor oil, transmission oil, hydraulic fluids, brake fluid, etc.) and industrial oils (e.g., industrial engine oils, metalworking oils, process oils, industrial grease, etc.).

**Valve** means any device for halting or regulating the flow of a liquid or gas through a passage, pipeline, inlet, outlet, or orifice; including, but not limited to, gate, globe, plug, ball, butterfly and needle valves.

**Vapor recovery system** means any equipment located at the source of potential gas emissions to the atmosphere or to a flare, that is composed of piping, connections, and, if necessary, flow-inducing devices, and that is used for routing the gas back into the process as a product and/or fuel. For purposes of § 98.233, routing emissions from a dehydrator regenerator still vent or flash tank separator vent to a regenerator fire-box/fire tubes does not meet the definition of vapor recovery system.

**Vaporization unit** means a process unit that performs controlled heat input to vaporize LNG to supply transmission and distribution pipelines or consumers with natural gas.

**Vegetable oil** means oils extracted from vegetation that are generally used as a feedstock in making biodiesel.

**Ventilation hole or shaft** means a vent hole, shaft, mine portal, adit or other mine entrance or exits employed at an underground coal mine to serve as the outlet or conduit to move air from the ventilation system out of the mine.

**Ventilation system** means a system that is used to control the concentration of methane and other gases within mine working areas through mine ventilation, rather than a mine degasification system. A ventilation system consists of fans that move air through the mine workings to dilute methane concentrations.

**Volatile solids** are the organic material in livestock manure and consist of both biodegradable and non-biodegradable fractions.

**Waelz kiln** means an inclined rotary kiln in which zinc-containing materials are charged together with a carbon reducing agent (e.g., petroleum coke, metallurgical coke, or anthracite coal).

**Waxes** means a solid or semi-solid material at 77 °F consisting of a mixture of hydrocarbons obtained or derived from petroleum fractions, or through a Fischer-Tropsch type process, in which the straight chained paraffin series predominates. This includes all marketable wax, whether crude or refined, with a congealing point between 80 (or 85) and 240 °F and a maximum oil content of 50 weight percent.

**Well completions** means the process that allows for the flow of petroleum or natural gas from newly drilled wells to expel drilling and reservoir fluids and test the reservoir flow characteristics, steps which may vent produced gas to the atmosphere via an open pit or tank. Well completion also involves connecting the well bore to the reservoir, which may include treating the formation or installing tubing, packer(s), or lifting equipment, steps that do not significantly vent natural gas to the atmosphere. This process may also include high-rate flowback of injected gas, water, oil, and proppant used to fracture and prop open new fractures in existing lower permeability gas reservoirs, steps that may vent large quantities of produced gas to the atmosphere.

**Well workover** means the process(es) of performing one or more of a variety of remedial operations on producing petroleum and natural gas wells to try to increase production. This process also includes high-rate flowback of injected gas, water, oil, and proppant used to re-fracture and prop-open new fractures in existing low permeability gas reservoirs, steps that may vent large quantities of produced gas to the atmosphere.

**Wellhead** means the piping, casing, tubing and connected valves protruding above the earth's surface for an oil and/or natural gas well. The wellhead ends where the flow line connects to a wellhead valve. Wellhead equipment includes all equipment, permanent and portable, located on the improved land area (i.e. well pad) surrounding one or multiple wellheads.

**Wet natural gas** means natural gas in which water vapor exceeds the concentration specified for commercially saleable natural gas delivered from transmission and distribution pipelines. This input stream to a natural gas dehydrator is referred to as "wet gas."

**Wood residuals** means materials recovered from three principal sources: Municipal solid waste (MSW); construction and demolition debris; and primary timber processing. Wood residuals recovered from MSW include wooden furniture, cabinets, pallets and containers, scrap lumber (from sources other than construction and demolition activities), and urban tree and landscape residues. Wood residuals from construction and demolition debris originate from the construction, repair, remodeling and demolition of houses and non-residential structures. Wood residuals from primary timber processing include bark, sawmill slabs and edgings, sawdust, and peeler log cores. Other sources of wood residuals include, but are not limited to, railroad ties, telephone and utility poles, pier and dock timbers, wastewater process sludge from paper mills, trim, sander dust, and sawdust from wood products manufacturing (including resinated wood product residuals), and logging residues.

**Wool fiberglass** means fibrous glass of random texture, including fiberglass insulation, and other products listed in NAICS 327993.

**Working capacity** , for the purposes of subpart TT of this part, means the maximum volume or mass of waste that is actually placed in the landfill from an individual or representative type of container (such as a tank, truck, or roll-off bin) used to convey wastes to the landfill, taking into account that the container may not be able to be 100 percent filled and/or 100 percent emptied for each load.

**You** means an owner or operator subject to Part 98.

**Zinc smelters** means a facility engaged in the production of zinc metal, zinc oxide, or zinc alloy products from zinc sulfide ore concentrates, zinc calcine, or zinc-bearing scrap and recycled materials through the use of pyrometallurgical techniques involving the reduction and volatilization of zinc-bearing feed materials charged to a furnace.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 39759, July 12, 2010; 75 FR 57686, Sept. 22, 2010; 75 FR 66457, Oct. 28, 2010; 75 FR 74487, Nov. 30, 2010; 75 FR 74816, Dec. 1, 2010; 75 FR 79137, Dec. 17, 2010; 76 FR 73900, Nov. 29, 2011; 76 FR 80573, Dec. 23, 2011; 78 FR 71948, Nov. 29, 2013; 79 FR 70385, Nov. 25, 2014; 79 FR 73778, Dec. 11, 2014; 81 FR 89249, Dec. 9, 2016; 81 FR 89250, Dec. 9, 2016; 89 FR 31891, Apr. 25, 2024; 89 FR 42219, May 14, 2024]

## § 98.7 What standardized methods are incorporated by reference into this part?

Certain material is incorporated by reference into this part with the approval of the Director of the FEDERAL REGISTER under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in this section, the EPA must publish a document in the FEDERAL REGISTER and the material must be available to the public. All approved incorporation by reference (IBR) material is available for inspection at the EPA and at the National Archives and

Records Administration (NARA). Contact EPA at: EPA Docket Center, Public Reading Room, EPA WJC West, Room 3334, 1301 Constitution Ave. NW, Washington, DC; phone: 202-566-1744; email: [Docket-customerservice@epa.gov](mailto:Docket-customerservice@epa.gov); website: [www.epa.gov/dockets/epa-docket-center-reading-room](http://www.epa.gov/dockets/epa-docket-center-reading-room). For information on the availability of this material at NARA, visit [www.archives.gov/federal-register/cfr/ibr-locations](http://www.archives.gov/federal-register/cfr/ibr-locations) or email [fr.inspection@nara.gov](mailto:fr.inspection@nara.gov). The material may be obtained from the following sources:

(a) [Reserved]

(b) The following material is available for purchase from the ASM International, 9639 Kinsman Road, Materials Park, OH 44073, (440) 338-5151, <http://www.asminternational.org>.

(1) ASM CS-104 UNS No. G10460—Alloy Digest April 1985 (Carbon Steel of Medium Carbon Content), incorporation by reference (IBR) approved for § 98.174(b).

(2) [Reserved]

(c) The following material is available for purchase from the American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>.

(1) ASME MFC-3M-2004 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi, incorporation by reference (IBR) approved for § 98.124(m)(1), § 98.324(e), § 98.354(d), § 98.354(h), § 98.344(c) and § 98.364(e).

(2) ASME MFC-4M-1986 (Reaffirmed 1997) Measurement of Gas Flow by Turbine Meters, IBR approved for § 98.124(m)(2), § 98.324(e), § 98.344(c), § 98.354(h), and § 98.364(e).

(3) ASME MFC-5M-1985 (Reaffirmed 1994) Measurement of Liquid Flow in Closed Conduits Using Transit-Time Ultrasonic Flow Meters, IBR approved for § 98.124(m)(3) and § 98.354(d).

(4) ASME MFC-6M-1998 Measurement of Fluid Flow in Pipes Using Vortex Flowmeters, IBR approved for § 98.124(m)(4), § 98.324(e), § 98.344(c), § 98.354(h), and § 98.364(e).

(5) ASME MFC-7M-1987 (Reaffirmed 1992) Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles, IBR approved for § 98.124(m)(5), § 98.324(e), § 98.344(c), § 98.354(h), and § 98.364(e).

(6) ASME MFC-9M-1988 (Reaffirmed 2001) Measurement of Liquid Flow in Closed Conduits by Weighing Method, IBR approved for § 98.124(m)(6).

(7) ASME MFC-11M-2006 Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters, IBR approved for § 98.124(m)(7), § 98.324(e), § 98.344(c), and § 98.354(h).

(8) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters, IBR approved for § 98.124(m)(8), § 98.324(e), § 98.344(c), § 98.354(h), and § 98.364(e).

(9) ASME MFC-16-2007 Measurement of Liquid Flow in Closed Conduits with Electromagnetic Flow Meters, IBR approved for § 98.354(d).

(10) ASME MFC-18M-2001 Measurement of Fluid Flow Using Variable Area Meters, IBR approved for § 98.324(e), § 98.344(c), § 98.354(h), and § 98.364(e).

(d) ASTM International (ASTM), 100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959; (800) 262-1373; [www.astm.org](http://www.astm.org).

- (1) ASTM C25-06, Standard Test Method for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime, approved February 15, 2006; IBR approved for §§ 98.114(b); 98.174(b); 98.184(b); 98.194(c); 98.334(b); and 98.504(b).
- (2) ASTM C114-09, Standard Test Methods for Chemical Analysis of Hydraulic Cement; IBR approved for § 98.84(a) through (c).
- (3) ASTM D235-02 (Reapproved 2007), Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent); IBR approved for § 98.6.
- (4) ASTM D240-02 (Reapproved 2007), Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter; IBR approved for § 98.254(e).
- (5) ASTM D388-05, Standard Classification of Coals by Rank; IBR approved for § 98.6.
- (6) ASTM D910-07a, Standard Specification for Aviation Gasolines; IBR approved for § 98.6.
- (7) ASTM D1826-94 (Reapproved 2003), Standard Test Method for Calorific (Heating) Value of Gases in Natural Gas Range by Continuous Recording Calorimeter; IBR approved for § 98.254(e).
- (8) ASTM D1836-07, Standard Specification for Commercial Hexanes; IBR approved for § 98.6.
- (9) ASTM D1941-91 (Reapproved 2007), Standard Test Method for Open Channel Flow Measurement of Water with the Parshall Flume, approved June 15, 2007; IBR approved for § 98.354(d).
- (10) ASTM D1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography; IBR approved for §§ 98.74(c); 98.164(b); 98.244(b); 98.254(d); 98.324(d); 98.344(b); 98.354(g).
- (11) ASTM D1946-90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography; IBR approved for §§ 98.74(c); 98.164(b); 98.254(d); 98.324(d); 98.344(b); 98.354(g); 98.364(c).
- (12) ASTM D2013-07, Standard Practice for Preparing Coal Samples for Analysis; IBR approved for § 98.164(b).
- (13) ASTM D2234/D2234M-07, Standard Practice for Collection of a Gross Sample of Coal; IBR approved for § 98.164(b).
- (14) ASTM D2502-04, Standard Test Method for Estimation of Mean Relative Molecular Mass of Petroleum Oils From Viscosity Measurements; IBR approved for § 98.74(c).
- (15) ASTM D2503-92 (Reapproved 2007), Standard Test Method for Relative Molecular Mass (Molecular Weight) of Hydrocarbons by Thermoelectric Measurement of Vapor Pressure; IBR approved for §§ 98.74(c); 98.254(d)(6).
- (16) ASTM D2505-88 (Reapproved 2004)e1, Standard Test Method for Ethylene, Other Hydrocarbons, and Carbon Dioxide in High-Purity Ethylene by Gas Chromatography; IBR approved for § 98.244(b).
- (17) ASTM D2593-93 (Reapproved 2009), Standard Test Method for Butadiene Purity and Hydrocarbon Impurities by Gas Chromatography, approved July 1, 2009; IBR approved for § 98.244(b).
- (18) ASTM D2597-94 (Reapproved 2004), Standard Test Method for Analysis of Demethanized Hydrocarbon Liquid Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography; IBR approved for § 98.164(b).

- (19) ASTM D2879-97 (Reapproved 2007), Standard Test Method for Vapor Pressure-Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteniscope (ASTM D2879), approved May 1, 2007; IBR approved for § 98.128.
- (20) ASTM D3176-15, Standard Practice for Ultimate Analysis of Coal and Coke, approved January 1, 2015; IBR approved for § 98.494(c).
- (21) ASTM D3176-89 (Reapproved 2002), Standard Practice for Ultimate Analysis of Coal and Coke; IBR approved for §§ 98.74(c); 98.164(b); 98.244(b); 98.284(c) and (d); 98.314(c), (d), and (f).
- (22) ASTM D3238-95 (Reapproved 2005), Standard Test Method for Calculation of Carbon Distribution and Structural Group Analysis of Petroleum Oils by the n-d-M Method; IBR approved for §§ 98.74(c); 98.164(b).
- (23) ASTM D3588-98 (Reapproved 2003), Standard Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels; IBR approved for § 98.254(e).
- (24) ASTM D3682-01 (Reapproved 2006), Standard Test Method for Major and Minor Elements in Combustion Residues from Coal Utilization Processes; IBR approved for § 98.144(b).
- (25) ASTM D4057-06, Standard Practice for Manual Sampling of Petroleum and Petroleum Products; IBR approved for § 98.164(b).
- (26) ASTM D4177-95 (Reapproved 2005), Standard Practice for Automatic Sampling of Petroleum and Petroleum Products; IBR approved for § 98.164(b).
- (27) ASTM D4809-06, Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method); IBR approved for § 98.254(e).
- (28) ASTM D4891-89 (Reapproved 2006), Standard Test Method for Heating Value of Gases in Natural Gas Range by Stoichiometric Combustion; IBR approved for §§ 98.254(e); 98.324(d).
- (29) ASTM D5291-02 (Reapproved 2007), Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants; IBR approved for §§ 98.74(c); 98.164(b); 98.244(b).
- (30) ASTM D5291-16, Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants, approved October 1, 2016; IBR approved for § 98.494(c).
- (31) ASTM D5373-08, Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal, approved February 1, 2008; IBR approved for §§ 98.74(c); 98.114(b); 98.164(b); 98.174(b); 98.184(b); 98.244(b); 98.274(b); 98.284(c) and (d); 98.314(c), (d), and (f); 98.334(b); 98.504(b).
- (32) ASTM D5373-21, Standard Test Methods for Determination of Carbon, Hydrogen, and Nitrogen in Analysis Samples of Coal and Carbon in Analysis Samples of Coal and Coke, approved April 1, 2021; IBR approved for § 98.494(c).
- (33) ASTM D5614-94 (Reapproved 2008), Standard Test Method for Open Channel Flow Measurement of Water with Broad-Crested Weirs, approved October 1, 2008; IBR approved for § 98.354(d).
- (34) ASTM D6060-96 (Reapproved 2001), Standard Practice for Sampling of Process Vents With a Portable Gas Chromatograph; IBR approved for § 98.244(b).

- (35) ASTM D6348-03, Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy; IBR approved for § 98.54(b); table I-9 to subpart I of this part; §§ 98.224(b); 98.414(n).
- (36) ASTM D6348-12 (Reapproved 2020) Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy, Approved December 1, 2020, IBR approved for § 98.234(i).
- (37) ASTM D6349-09, Standard Test Method for Determination of Major and Minor Elements in Coal, Coke, and Solid Residues from Combustion of Coal and Coke by Inductively Coupled Plasma—Atomic Emission Spectrometry; IBR approved for § 98.144(b).
- (38) ASTM D6609-08, Standard Guide for Part-Stream Sampling of Coal; IBR approved for § 98.164(b).
- (39) ASTM D6751-08, Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels; IBR approved for § 98.6.
- (40) ASTM D6866-16, Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis, approved June 1, 2016; IBR approved for §§ 98.34(d) and (e); 98.36(e).
- (41) ASTM D6883-04, Standard Practice for Manual Sampling of Stationary Coal from Railroad Cars, Barges, Trucks, or Stockpiles; IBR approved for § 98.164(b).
- (42) ASTM D7359-08, Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC) (ASTM D7359), approved October 15, 2008; IBR approved for § 98.124(e)(2).
- (43) ASTM D7430-08ae1, Standard Practice for Mechanical Sampling of Coal; IBR approved for § 98.164(b).
- (44) ASTM D7459-08, Standard Practice for Collection of Integrated Samples for the Speciation of Biomass (Biogenic) and Fossil-Derived Carbon Dioxide Emitted from Stationary Emissions Sources; IBR approved for §§ 98.34(d) and (e); 98.36(e).
- (45) ASTM D7633-10, Standard Test Method for Carbon Black—Carbon Content, approved May 15, 2010; IBR approved for § 98.244(b).
- (46) ASTM E359-00 (Reapproved 2005)e1, Standard Test Methods for Analysis of Soda Ash (Sodium Carbonate); IBR approved for § 98.294(a) and (b).
- (47) ASTM E415-17, Standard Test Method for Analysis of Carbon and Low-Alloy Steel by Spark Atomic Emission Spectrometry, approved May 15, 2017; IBR approved for § 98.174(b).
- (48) ASTM E1019-08, Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques; IBR approved for § 98.174(b).
- (49) ASTM E1915-07a, Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared-Absorption Spectrometry; IBR approved for § 98.174(b).
- (50) ASTM E1941-04, Standard Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys; IBR approved for §§ 98.114(b); 98.184(b); 98.334(b).

(51) ASTM UOP539-97, Refinery Gas Analysis by Gas Chromatography; IBR approved for §§ 98.164(b); 98.244(b); 98.254(d); 98.324(d); 98.344(b); 98.354(g).

(e) CSA Group (CSA), 178 Rexdale Boulevard, Toronto, Ontario Canada M9W 1R3; (800) 463-6727; <https://shop.csa.ca>.

(1) CSA/ANSI ISO 27916:19, Carbon dioxide capture, transportation and geological storage—Carbon dioxide storage using enhanced oil recovery (CO<sub>2</sub>-EOR), approved August 30, 2019; IBR approved for §§ 98.470(c); 98.480(a); 98.481(a) through (c); 98.482; 98.483; 98.484; 98.485; 98.486(g); 98.487; 98.488(a)(5); 98.489.

Note 1 to paragraph (e)(1): This standard is also available from ISO as ISO 27916:2019(E).

(2) [Reserved]

(f) The following material is available for purchase from the Gas Processors Association (GPA), 6526 East 60th Street, Tulsa, Oklahoma 74143, (918) 493-3872, <http://www.gasprocessors.com>.

(1) [Reserved]

(2) GPA 2261-00 Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography, IBR approved for § 98.164(b), § 98.254(d), § 98.344(b), and § 98.354(g).

(g) The following material is available for purchase from the International Standards Organization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, + 41 22 749 01 11, <http://www.iso.org/iso/home.htm>.

(1) ISO 3170: Petroleum liquids—Manual sampling—Third Edition 2004-02-01, IBR approved for § 98.164(b).

(2) ISO 3171: Petroleum Liquids—Automatic pipeline sampling—Second Edition 1988-12-01, IBR approved for § 98.164(b).

(3) [Reserved]

(4) ISO/CSAPR 15349-1: 1998, Unalloyed steel—Determination of low carbon content. Part 1: Infrared absorption method after combustion in an electric resistance furnace (by peak separation) (1998-10-15)—First Edition, IBR approved for § 98.174(b).

(5) ISO/CSAPR 15349-3: 1998, Unalloyed steel—Determination of low carbon content. Part 3: Infrared absorption method after combustion in an electric resistance furnace (with preheating) (1998-10-15)—First Edition, IBR approved for § 98.174(b).

(h) The following material is available for purchase from the National Lime Association (NLA), 200 North Glebe Road, Suite 800, Arlington, Virginia 22203, (703) 243-5463, <http://www.lime.org>.

(1) CO<sub>2</sub> Emissions Calculation Protocol for the Lime Industry—English Units Version, February 5, 2008 Revision—National Lime Association, incorporation by reference (IBR) approved for § 98.194(c) and § 98.194(e).

(2) [Reserved]

(i) National Institute of Standards and Technology (NIST), 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, (800) 877-8339, [www.nist.gov/](http://www.nist.gov/).

- (1) NIST HB 44-2023: Specifications, Tolerances, and Other Technical Requirements For Weighing and Measuring Devices, 2023 edition, approved November 18, 2022; IBR approved for § 98.494(b).
- (2) Specifications, Tolerances, and Other Technical Requirements For Weighing and Measuring Devices, NIST Handbook 44 (2009); IBR approved for §§ 98.244(b); 98.344(a).
- (j) The following material is available for purchase from the Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092, (800) 332-8686, <http://www.tappi.org>.
  - (1) T650 om-05 Solids Content of Black Liquor, TAPPI, incorporation by reference (IBR) approved for § 98.276(c) and § 98.277(d).
  - (2) T684 om-06 Gross Heating Value of Black Liquor, TAPPI, incorporation by reference (IBR) approved for § 98.274(b).
- (k) The following material is available for purchase from Standard Methods, at <http://www.standardmethods.org>, (877) 574-1233; or, through a joint publication agreement from the American Public Health Association (APHA), P.O. Box 933019, Atlanta, GA 31193-3019, (888) 320-APHA (2742), <http://www.apha.org/publications/pubscontact/>.
  - (1) Method 2540G Total, Fixed, and Volatile Solids in Solid and Semisolid Samples, IBR approved for § 98.464(b).
  - (2) [Reserved]
- (l) The following material is available from the U.S. Department of Labor, Mine Safety and Health Administration, 1100 Wilson Boulevard, 21st Floor, Arlington, VA 22209-3939, (202) 693-9400, <http://www.msha.gov>.
  - (1) PH16-V-1, Coal Mine Safety and Health General Inspection Procedures Handbook, June 2016, IBR approved for § 98.324(b).
  - (2) [Reserved]
- (m) The following material is available from the U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW., Washington, DC 20460, (202) 272-0167, <http://www.epa.gov>.
  - (1) NPDES Compliance Inspection Manual, Chapter 5, Sampling, EPA 305-X-04-001, July 2004, <http://www.epa.gov/compliance/monitoring/programs/cwa/npdes.html>, IBR approved for § 98.354(c).
  - (2) U.S. EPA NPDES Permit Writers' Manual, Section 7.1.3, Sample Collection Methods, EPA 833-B-96-003, December 1996, <http://www.epa.gov/npdes/pubs/owm0243.pdf>, IBR approved for § 98.354(c).
  - (3) Protocol for Measuring Destruction or Removal Efficiency (DRE) of Fluorinated Greenhouse Gas Abatement Equipment in Electronics Manufacturing, Version 1, EPA-430-R-10-003, March 2010 (EPA 430-R-10-003), approved March 2010; IBR approved for §§ 98.94(e); 98.94(f) and (g); 98.97(b) and (d); 98.98; appendix A to subpart I of this part; §§ 98.124(e); 98.414(n). (Also available from: [www.epa.gov/sites/default/files/2016-02/documents/dre\\_protocol.pdf](http://www.epa.gov/sites/default/files/2016-02/documents/dre_protocol.pdf).)
  - (4) Emissions Inventory Improvement Program, Volume II: Chapter 16, Methods for Estimating Air Emissions from Chemical Manufacturing Facilities, August 2007, Final, <http://www.epa.gov/ttnchie1/eiip/techreport/volume02/index.html>, IBR approved for § 98.123(c)(1)(i)(A).



- (5) Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, November 1995 (EPA-453/R-95-017), <http://www.epa.gov/ttnchie1/efdocs/equiplks.pdf>, IBR approved for § 98.123(d)(1)(i), § 98.123(d)(1)(ii), § 98.123(d)(1)(iii), and § 98.124(f)(2).
- (6) Tracer Gas Protocol for the Determination of Volumetric Flow Rate Through the Ring Pipe of the Xact Multi-Metals Monitoring System, also known as Other Test Method 24 (Tracer Gas Protocol), Eli Lilly and Company Tippecanoe Laboratories, September 2006, <http://www.epa.gov/ttn/emc/prelim/otm24.pdf>, IBR approved for § 98.124(e)(1)(ii).
- (7) Approved Alternative Method 012: An Alternate Procedure for Stack Gas Volumetric Flow Rate Determination (Tracer Gas) (ALT-012), U.S. Environmental Protection Agency Emission Measurement Center, May 23, 1994, <http://www.epa.gov/ttn/emc/approalt/alt-012.pdf>, IBR approved for § 98.124(e)(1)(ii).
- (8) Protocol for Measurement of Tetrafluoromethane (CF<sub>4</sub>) and Hexafluoroethane (C<sub>2</sub>F<sub>6</sub>) Emissions from Primary Aluminum Production (2008), <http://www.epa.gov/highgwp/aluminum-pfc/documents/measureprotocol.pdf>, IBR approved for § 98.64(a).
- (9) AP 42, Section 5.2, Transportation and Marketing of Petroleum Liquids, July 2008, (AP 42, Section 5.2); <http://www.epa.gov/ttn/chief/ap42/ch05/final/c05s02.pdf>; in Chapter 5, Petroleum Industry, of AP 42, Compilation of Air Pollutant Emission Factors, 5th Edition, Volume I, IBR approved for § 98.253(n).
- (10) Method 9060A, Total Organic Carbon, Revision 1, November 2004 (Method 9060A), <http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/9060a.pdf>; in EPA Publication No. SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, IBR approved for § 98.244(b)(4)(viii).
- (11) Method 8031, Acrylonitrile By Gas Chromatography, Revision 0, September 1994 (Method 8031), <http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/8031.pdf>; in EPA Publication No. SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, IBR approved for § 98.244(b)(4)(viii).
- (12) Method 8021B, Aromatic and Halogenated Volatiles By Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors, Revision 2, December 1996 (Method 8021B), <http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/8021b.pdf>; in EPA Publication No. SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, IBR approved for § 98.244(b)(4)(viii).
- (13) Method 8015C, Nonhalogenated Organics By Gas Chromatography, Revision 3, February 2007 (Method 8015C). <http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/8015c.pdf>; in EPA Publication No. SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, IBR approved for § 98.244(b)(4)(viii).
- (14) AP 42, Section 7.1, Organic Liquid Storage Tanks, November 2006 (AP 42, Section 7.1), <http://www.epa.gov/ttn/chief/ap42/ch07/final/c07s01.pdf>; in Chapter 7, Liquid Storage Tanks, of AP 42, Compilation of Air Pollutant Emission Factors, 5th Edition, Volume I, IBR approved for § 98.253(m)(1) and § 98.256(o)(2)(i).
- (15) Other Test Method 52 (OTM-52), Method for Determination of Combustion Efficiency from Enclosed Combustors Located at Oil and Gas Production Facilities, dated September 26, 2023, <https://www.epa.gov/emc/emc-other-test-methods>, IBR approved for § 98.233(n).

(n)-(o) [Reserved]

(p) The following material is available for purchase from the American Association of Petroleum Geologists, 1444 South Boulder Avenue, Tulsa, Oklahoma 74119, (918) 584-2555, <http://www.aapg.org>.

(1) Geologic Note: AAPG-CSD Geologic Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laure G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991), pages 1644-1651, IBR approved for § 98.238.

(2) Alaska Geological Province Boundary Map, Compiled by the American Association of Petroleum Geologists Committee on Statistics of Drilling in cooperation with the USGS, 1978, IBR approved for § 98.238.

(q) The following material is available from the Energy Information Administration (EIA), 1000 Independence Ave., SW., Washington, DC 20585, (202) 586-8800, [http://www.eia.doe.gov/pub/oil\\_gas/natural\\_gas/data\\_publications/field\\_code\\_master\\_list/current/pdf/fcmLall.pdf](http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/field_code_master_list/current/pdf/fcmLall.pdf).

(1) Oil and Gas Field Code Master List 2008, DOE/EIA0370(08), January 2009, IBR approved for § 98.238.

(2) [Reserved]

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 39759, July 12, 2010; 75 FR 66458, Oct. 28, 2010; 75 FR 74488, Nov. 30, 2010; 75 FR 74816, Dec. 1, 2010; 75 FR 79138, Dec. 17, 2010; 78 FR 68202, Nov. 13, 2013; 78 FR 71948, Nov. 29, 2013; 81 FR 89250, Dec. 9, 2016; 89 FR 31892, Apr. 25, 2024; 89 FR 42220, May 14, 2024]

## § 98.8 What are the compliance and enforcement provisions of this part?

Any violation of any requirement of this part shall be a violation of the Clean Air Act, including section 114 (42 U.S.C. 7414). A violation includes but is not limited to failure to report GHG emissions, failure to collect data needed to calculate GHG emissions, failure to continuously monitor and test as required, failure to retain records needed to verify the amount of GHG emissions, and failure to calculate GHG emissions following the methodologies specified in this part. Each day of a violation constitutes a separate violation.

## § 98.9 Addresses.

All requests, notifications, and communications to the Administrator pursuant to this part must be submitted electronically and in a format as specified by the Administrator. For example, any requests, notifications and communications that can be submitted through the electronic GHG reporting tool, must be submitted through that tool. If not specified, requests, notifications or communications shall be submitted to the following address:

(a) For U.S. mail. Director, Climate Change Division, 1200 Pennsylvania Ave., NW., Mail Code: 6207J, Washington, DC 20460.

(b) For package deliveries. Director, Climate Change Division, 1310 L St, NW., Washington, DC 20005.

[74 FR 56374, Oct. 30, 2009, as amended at 76 FR 73900, Nov. 29, 2011]

**Table A-1 to Subpart A of Part 98—Global Warming Potentials, 100-Year Time Horizon**

**TABLE A-1 TO SUBPART A OF PART 98—GLOBAL WARMING POTENTIALS, 100-YEAR TIME**

| Name                                  | CAS No.    | Chemical formula                                                                                 |
|---------------------------------------|------------|--------------------------------------------------------------------------------------------------|
| CHEMICAL-SPECIFIC GWPs                |            |                                                                                                  |
| Carbon dioxide                        | 124-38-9   | CO <sub>2</sub>                                                                                  |
| Methane                               | 74-82-8    | CH <sub>4</sub>                                                                                  |
| Nitrous oxide                         | 10024-97-2 | N <sub>2</sub> O                                                                                 |
| FULLY FLUORINATED GHGs                |            |                                                                                                  |
| Sulfur hexafluoride                   | 2551-62-4  | SF <sub>6</sub>                                                                                  |
| Trifluoromethyl sulphur pentafluoride | 373-80-8   | SF <sub>5</sub> CF <sub>3</sub>                                                                  |
| Nitrogen trifluoride                  | 7783-54-2  | NF <sub>3</sub>                                                                                  |
| PFC-14 (Perfluoromethane)             | 75-73-0    | CF <sub>4</sub>                                                                                  |
| PFC-116 (Perfluoroethane)             | 76-16-4    | C <sub>2</sub> F <sub>6</sub>                                                                    |
| PFC-218 (Perfluoropropane)            | 76-19-7    | C <sub>3</sub> F <sub>8</sub>                                                                    |
| Perfluorocyclopropane                 | 931-91-9   | c-C <sub>3</sub> F <sub>6</sub>                                                                  |
| PFC-3-1-10 (Perfluorobutane)          | 355-25-9   | C <sub>4</sub> F <sub>10</sub>                                                                   |
| PFC-318 (Perfluorocyclobutane)        | 115-25-3   | c-C <sub>4</sub> F <sub>8</sub>                                                                  |
| Perfluorotetrahydrofuran              | 773-14-8   | c-C <sub>4</sub> F <sub>8</sub> O                                                                |
| PFC-4-1-12 (Perfluoropentane)         | 678-26-2   | C <sub>5</sub> F <sub>12</sub>                                                                   |
| PFC-5-1-14 (Perfluorohexane, FC-72)   | 355-42-0   | C <sub>6</sub> F <sub>14</sub>                                                                   |
| PFC-6-1-12                            | 335-57-9   | C <sub>7</sub> F <sub>16</sub> ; CF <sub>3</sub> (CF <sub>2</sub> ) <sub>4</sub> CF <sub>3</sub> |
| PFC-7-1-18                            | 307-34-6   | C <sub>8</sub> F <sub>18</sub> ; CF <sub>3</sub> (CF <sub>2</sub> ) <sub>5</sub> CF <sub>3</sub> |
| PFC-9-1-18                            | 306-94-5   | C <sub>10</sub> F <sub>18</sub>                                                                  |
| PFPME (HT-70)                         | NA         | CF <sub>3</sub> OCF(CF <sub>3</sub> )OCF <sub>2</sub> OCF <sub>3</sub>                           |
| Perfluorodecalin (cis)                | 60433-11-6 | Z-C <sub>10</sub> F <sub>18</sub>                                                                |
| Perfluorodecalin (trans)              | 60433-12-7 | E-C <sub>10</sub> F <sub>18</sub>                                                                |
| Perfluorotriethylamine                | 359-70-6   | N(C <sub>2</sub> F <sub>5</sub> ) <sub>3</sub>                                                   |
| Perfluorotripropylamine               | 338-83-0   | N(CF <sub>2</sub> CF <sub>2</sub> CH <sub>3</sub> ) <sub>3</sub>                                 |
| Perfluorotributylamine                | 311-89-7   | N(CF <sub>2</sub> CF <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> ) <sub>3</sub>                 |
| Perfluorotripentylamine               | 338-84-1   | N(CF <sub>2</sub> CF <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> ) <sub>3</sub> |

| Name                                                                                                 | CAS No.     | Chemical formula                                                                                         |
|------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------|
| SATURATED HYDROFLUOROCARBONS (HFCs) WITH TWO OR FEWER CARBON-HYDROGEN BONDS                          |             |                                                                                                          |
| (4s,5s)-1,1,2,2,3,3,4,5-octafluorocyclopentane                                                       | 158389-18-5 | trans-cyc (-CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> -)                           |
| HFC-23                                                                                               | 75-46-7     | CHF <sub>3</sub>                                                                                         |
| HFC-32                                                                                               | 75-10-5     | CH <sub>2</sub> F <sub>2</sub>                                                                           |
| HFC-125                                                                                              | 354-33-6    | C <sub>2</sub> HF <sub>5</sub>                                                                           |
| HFC-134                                                                                              | 359-35-3    | C <sub>2</sub> H <sub>2</sub> F <sub>4</sub>                                                             |
| HFC-134a                                                                                             | 811-97-2    | CH <sub>2</sub> FCF <sub>3</sub>                                                                         |
| HFC-227ca                                                                                            | 2252-84-8   | CF <sub>3</sub> CF <sub>2</sub> CHF <sub>3</sub>                                                         |
| HFC-227ea                                                                                            | 431-89-0    | C <sub>3</sub> HF <sub>7</sub>                                                                           |
| HFC-236cb                                                                                            | 677-56-5    | CH <sub>2</sub> FCF <sub>2</sub> CF <sub>3</sub>                                                         |
| HFC-236ea                                                                                            | 431-63-0    | CHF <sub>2</sub> CHF <sub>2</sub> CF <sub>3</sub>                                                        |
| HFC-236fa                                                                                            | 690-39-1    | C <sub>3</sub> H <sub>2</sub> F <sub>6</sub>                                                             |
| HFC-329p                                                                                             | 375-17-7    | CHF <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                                                         |
| HFC-43-10mee                                                                                         | 138495-42-8 | CF <sub>3</sub> CFHCFH <sub>2</sub>                                                                      |
| SATURATED HYDROFLUOROCARBONS (HFCs) WITH THREE OR MORE CARBON-HYDROGEN BONDS                         |             |                                                                                                          |
| 1,1,2,2,3,3-hexafluorocyclopentane                                                                   | 123768-18-3 | cyc (-CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> -)                 |
| 1,1,2,2,3,3,4-heptafluorocyclopentane                                                                | 15290-77-4  | cyc (-CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> -) |
| HFC-41                                                                                               | 593-53-3    | CH <sub>3</sub> F                                                                                        |
| HFC-143                                                                                              | 430-66-0    | C <sub>2</sub> H <sub>3</sub> F <sub>3</sub>                                                             |
| HFC-143a                                                                                             | 420-46-2    | C <sub>2</sub> H <sub>3</sub> F <sub>3</sub>                                                             |
| HFC-152                                                                                              | 624-72-6    | CH <sub>2</sub> FCH <sub>2</sub> F                                                                       |
| HFC-152a                                                                                             | 75-37-6     | CH <sub>3</sub> CHF <sub>2</sub>                                                                         |
| HFC-161                                                                                              | 353-36-6    | CH <sub>3</sub> CH <sub>2</sub> F                                                                        |
| HFC-245ca                                                                                            | 679-86-7    | C <sub>3</sub> H <sub>3</sub> F <sub>5</sub>                                                             |
| HFC-245cb                                                                                            | 1814-88-6   | CF <sub>3</sub> CF <sub>2</sub> CH <sub>3</sub>                                                          |
| HFC-245ea                                                                                            | 24270-66-4  | CHF <sub>2</sub> CHF <sub>2</sub> CF <sub>3</sub>                                                        |
| HFC-245eb                                                                                            | 431-31-2    | CH <sub>2</sub> FCHF <sub>2</sub> CF <sub>3</sub>                                                        |
| HFC-245fa                                                                                            | 460-73-1    | CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                                                         |
| HFC-263fb                                                                                            | 421-07-8    | CH <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>                                                          |
| HFC-272ca                                                                                            | 420-45-1    | CH <sub>3</sub> CF <sub>2</sub> CH <sub>3</sub>                                                          |
| HFC-365mfc                                                                                           | 406-58-6    | CH <sub>3</sub> CF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                                          |
| SATURATED HYDROFLUOROETHERS (HFES) AND HYDROCHLOROFLUOROETHERS (HCFES) WITH ONE CARBON-HYDROGEN BOND |             |                                                                                                          |

page 85 of 930

| Name                                                                                            | CAS No.     | Chemical formula                                                         |
|-------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------|
| HFE-245fa2                                                                                      | 1885-48-9   | CHF <sub>2</sub> OCH <sub>2</sub>                                        |
| HFE-254cb1                                                                                      | 425-88-7    | CH <sub>3</sub> OCF <sub>2</sub> C                                       |
| HFE-263fb2                                                                                      | 460-43-5    | CF <sub>3</sub> CH <sub>2</sub> OC                                       |
| HFE-263m1; R-E-143a                                                                             | 690-22-2    | CF <sub>3</sub> OCH <sub>2</sub> C                                       |
| HFE-347mcc3 (HFE-7000)                                                                          | 375-03-1    | CH <sub>3</sub> OCF <sub>2</sub> C                                       |
| HFE-347mcf2                                                                                     | 171182-95-9 | CF <sub>3</sub> CF <sub>2</sub> OCH                                      |
| HFE-347mmy1                                                                                     | 22052-84-2  | CH <sub>3</sub> OCF(CF                                                   |
| HFE-347mmz1 (Sevoflurane)                                                                       | 28523-86-6  | (CF <sub>3</sub> ) <sub>2</sub> CHOO                                     |
| HFE-347pcf2                                                                                     | 406-78-0    | CHF <sub>2</sub> CF <sub>2</sub> OC                                      |
| HFE-356mec3                                                                                     | 382-34-3    | CH <sub>3</sub> OCF <sub>2</sub> C                                       |
| HFE-356mff2                                                                                     | 333-36-8    | CF <sub>3</sub> CH <sub>2</sub> OC                                       |
| HFE-356mmz1                                                                                     | 13171-18-1  | (CF <sub>3</sub> ) <sub>2</sub> CHOO                                     |
| HFE-356pcc3                                                                                     | 160620-20-2 | CH <sub>3</sub> OCF <sub>2</sub> C                                       |
| HFE-356pcf2                                                                                     | 50807-77-7  | CHF <sub>2</sub> CH <sub>2</sub> O<br>CHF <sub>2</sub>                   |
| HFE-356pcf3                                                                                     | 35042-99-0  | CHF <sub>2</sub> OCH <sub>2</sub><br>CHF <sub>2</sub>                    |
| HFE-365mcf2                                                                                     | 22052-81-9  | CF <sub>3</sub> CF <sub>2</sub> OCH                                      |
| HFE-365mcf3                                                                                     | 378-16-5    | CF <sub>3</sub> CF <sub>2</sub> CH <sub>2</sub>                          |
| HFE-374pc2                                                                                      | 512-51-6    | CH <sub>3</sub> CH <sub>2</sub> OC                                       |
| HFE-449s1 (HFE-7100) Chemical blend                                                             | 163702-07-6 | C <sub>4</sub> F <sub>9</sub> OCH <sub>3</sub>                           |
|                                                                                                 | 163702-08-7 | (CF <sub>3</sub> ) <sub>2</sub> CFCF                                     |
| HFE-569sf2 (HFE-7200) Chemical blend                                                            | 163702-05-4 | C <sub>4</sub> F <sub>9</sub> OC <sub>2</sub> H                          |
|                                                                                                 | 163702-06-5 | (CF <sub>3</sub> ) <sub>2</sub> CFCF                                     |
| HFE-7300                                                                                        | 132182-92-4 | (CF <sub>3</sub> ) <sub>2</sub> CFCF                                     |
|                                                                                                 |             | CF <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                          |
| HFE-7500                                                                                        | 297730-93-9 | n-C <sub>3</sub> F <sub>7</sub> CFO<br>CF(CF <sub>3</sub> ) <sub>2</sub> |
| HG'-01                                                                                          | 73287-23-7  | CH <sub>3</sub> OCF <sub>2</sub> C                                       |
| HG'-02                                                                                          | 485399-46-0 | CH <sub>3</sub> O(CF <sub>2</sub> C<br>CH <sub>3</sub>                   |
| HG'-03                                                                                          | 485399-48-2 | CH <sub>3</sub> O(CF <sub>2</sub> C<br>CH <sub>3</sub>                   |
| Difluoro(methoxy)methane                                                                        | 359-15-9    | CH <sub>3</sub> OCHF <sub>2</sub>                                        |
| 2-Chloro-1,1,2-trifluoro-1-methoxyethane                                                        | 425-87-6    | CH <sub>3</sub> OCF <sub>2</sub> C                                       |
| 1-Ethoxy-1,1,2,2,3,3,3-heptafluoropropane                                                       | 22052-86-4  | CF <sub>3</sub> CF <sub>2</sub> CF <sub>2</sub><br>CH <sub>3</sub>       |
| 2-Ethoxy-3,3,4,4,5-pentafluorotetrahydro-2,5-bis[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]- | 920979-28-8 | C <sub>12</sub> H <sub>5</sub> F <sub>19</sub> O                         |

| Name                                                                          | CAS No.      | Chemical formula                                                                                   |
|-------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------|
| furan                                                                         |              |                                                                                                    |
| 1-Ethoxy-1,1,2,3,3,3-hexafluoropropane                                        | 380-34-7     | CF <sub>3</sub> CHFCF <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>                                 |
| Fluoro(methoxy)methane                                                        | 460-22-0     | CH <sub>3</sub> OCH <sub>2</sub> F                                                                 |
| 1,1,2,2-Tetrafluoro-3-methoxy-propane; Methyl 2,2,3,3-tetrafluoropropyl ether | 60598-17-6   | CHF <sub>2</sub> CF <sub>2</sub> CH <sub>2</sub> OCH <sub>3</sub>                                  |
| 1,1,2,2-Tetrafluoro-1-(fluoromethoxy)ethane                                   | 37031-31-5   | CH <sub>2</sub> FOCHF <sub>2</sub> CF <sub>2</sub>                                                 |
| Difluoro(fluoromethoxy)methane                                                | 461-63-2     | CH <sub>2</sub> FOCHF <sub>2</sub>                                                                 |
| Fluoro(fluoromethoxy)methane                                                  | 462-51-1     | CH <sub>2</sub> FOCH <sub>2</sub>                                                                  |
| SATURATED CHLOROFLUOROCARBONS (CFCs)                                          |              |                                                                                                    |
| E-R316c                                                                       | 3832-15-3    | trans-cyc (-C(CF <sub>2</sub> ) <sub>2</sub> CClF-)                                                |
| Z-R316c                                                                       | 3934-26-7    | cis-cyc (-C(CF <sub>2</sub> ) <sub>2</sub> CClF-)                                                  |
| FLUORINATED FORMATES                                                          |              |                                                                                                    |
| Trifluoromethyl formate                                                       | 85358-65-2   | HCOOCF <sub>3</sub>                                                                                |
| Perfluoroethyl formate                                                        | 313064-40-3  | HCOOCF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                                                |
| 1,2,2,2-Tetrafluoroethyl formate                                              | 481631-19-0  | HCOOCHFCF <sub>2</sub> CF <sub>3</sub>                                                             |
| Perfluorobutyl formate                                                        | 197218-56-7  | HCOOCF <sub>2</sub> CH <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                                |
| Perfluoropropyl formate                                                       | 271257-42-2  | HCOOCF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                                                |
| 1,1,1,3,3,3-Hexafluoropropan-2-yl formate                                     | 856766-70-6  | HCOOCH(CF <sub>3</sub> )CF <sub>2</sub> CF <sub>3</sub>                                            |
| 2,2,2-Trifluoroethyl formate                                                  | 32042-38-9   | HCOOCH <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                                                |
| 3,3,3-Trifluoropropyl formate                                                 | 1344118-09-7 | HCOOCH <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                                |
| FLUORINATED ACETATES                                                          |              |                                                                                                    |
| Methyl 2,2,2-trifluoroacetate                                                 | 431-47-0     | CF <sub>3</sub> COOCH <sub>3</sub>                                                                 |
| 1,1-Difluoroethyl 2,2,2-trifluoroacetate                                      | 1344118-13-3 | CF <sub>3</sub> COOCF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                                 |
| Difluoromethyl 2,2,2-trifluoroacetate                                         | 2024-86-4    | CF <sub>3</sub> COOCHFCF <sub>2</sub>                                                              |
| 2,2,2-Trifluoroethyl 2,2,2-trifluoroacetate                                   | 407-38-5     | CF <sub>3</sub> COOCH <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                                 |
| Methyl 2,2-difluoroacetate                                                    | 433-53-4     | HCF <sub>2</sub> COOCH <sub>3</sub>                                                                |
| Perfluoroethyl acetate                                                        | 343269-97-6  | CH <sub>3</sub> COOCF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>                                 |
| Trifluoromethyl acetate                                                       | 74123-20-9   | CH <sub>3</sub> COOCF <sub>3</sub>                                                                 |
| Perfluoropropyl acetate                                                       | 1344118-10-0 | CH <sub>3</sub> COOCF <sub>2</sub> CH <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub>                 |
| Perfluorobutyl acetate                                                        | 209597-28-4  | CH <sub>3</sub> COOCF <sub>2</sub> CH <sub>2</sub> CF <sub>2</sub> CF <sub>2</sub> CF <sub>3</sub> |
| Ethyl 2,2,2-trifluoroacetate                                                  | 383-63-1     | CF <sub>3</sub> COOCH <sub>2</sub> CH <sub>3</sub>                                                 |
| CARBONOFUORIDATES                                                             |              |                                                                                                    |

| Name                                                                                   | CAS No.      | Chemical                                                                                                        |
|----------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------|
| Methyl carbonofluoride                                                                 | 1538-06-3    | FCOOCH <sub>3</sub>                                                                                             |
| 1,1-Difluoroethyl carbonofluoride                                                      | 1344118-11-1 | FCOOCF <sub>2</sub> CH <sub>3</sub>                                                                             |
| FLUORINATED ALCOHOLS OTHER THAN FLUOROTELOMER ALCOHOLS                                 |              |                                                                                                                 |
| Bis(trifluoromethyl)-methanol                                                          | 920-66-1     | (CF <sub>3</sub> ) <sub>2</sub> CHOH                                                                            |
| 2,2,3,3,4,4,5,5-Octafluorocyclopentanol                                                | 16621-87-7   | cyc -(CF <sub>2</sub> ) <sub>4</sub> OH                                                                         |
| 2,2,3,3,3-Pentafluoropropanol                                                          | 422-05-9     | CF <sub>3</sub> CF <sub>2</sub> CH <sub>2</sub> OH                                                              |
| 2,2,3,3,4,4,4-Heptafluorobutan-1-ol                                                    | 375-01-9     | C <sub>3</sub> F <sub>7</sub> CH <sub>2</sub> OH                                                                |
| 2,2,2-Trifluoroethanol                                                                 | 75-89-8      | CF <sub>3</sub> CH <sub>2</sub> OH                                                                              |
| 2,2,3,4,4,4-Hexafluoro-1-butanol                                                       | 382-31-0     | CF <sub>3</sub> CHF CF <sub>2</sub> CH <sub>2</sub> OH                                                          |
| 2,2,3,3-Tetrafluoro-1-propanol                                                         | 76-37-9      | CHF <sub>2</sub> CF <sub>2</sub> CH <sub>2</sub> OH                                                             |
| 2,2-Difluoroethanol                                                                    | 359-13-7     | CHF <sub>2</sub> CH <sub>2</sub> OH                                                                             |
| 2-Fluoroethanol                                                                        | 371-62-0     | CH <sub>2</sub> FCH <sub>2</sub> OH                                                                             |
| 4,4,4-Trifluorobutan-1-ol                                                              | 461-18-7     | CF <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> OH                                              |
| NON-CYCLIC, UNSATURATED PERFLUOROCARBONS (PFCs)                                        |              |                                                                                                                 |
| PFC-1114; TFE                                                                          | 116-14-3     | CF <sub>2</sub> = CF <sub>2</sub> ; C <sub>2</sub> F <sub>4</sub>                                               |
| PFC-1216; Dyneon HFP                                                                   | 116-15-4     | C <sub>3</sub> F <sub>6</sub> ; CF <sub>3</sub> CF = CF <sub>2</sub>                                            |
| Perfluorobut-2-ene                                                                     | 360-89-4     | CF <sub>3</sub> CF = CF <sub>2</sub>                                                                            |
| Perfluorobut-1-ene                                                                     | 357-26-6     | CF <sub>3</sub> CF <sub>2</sub> CF = CF <sub>2</sub>                                                            |
| Perfluorobuta-1,3-diene                                                                | 685-63-2     | CF <sub>2</sub> = CF CF = CF <sub>2</sub>                                                                       |
| NON-CYCLIC, UNSATURATED HYDROFLUOROCARBONS (HFCs) AND HYDROCHLOROFLUOROCARBONS (HCFCs) |              |                                                                                                                 |
| HFC-1132a; VF2                                                                         | 75-38-7      | C <sub>2</sub> H <sub>2</sub> F <sub>2</sub> ; CF <sub>2</sub> = CF <sub>2</sub>                                |
| HFC-1141; VF                                                                           | 75-02-5      | C <sub>2</sub> H <sub>3</sub> F; CH <sub>2</sub> = CF <sub>2</sub>                                              |
| (E)-HFC-1225ye                                                                         | 5595-10-8    | CF <sub>3</sub> CF = CH <sub>2</sub>                                                                            |
| (Z)-HFC-1225ye                                                                         | 5528-43-8    | CF <sub>3</sub> CF = CH <sub>2</sub>                                                                            |
| Solstice 1233zd(E)                                                                     | 102687-65-0  | C <sub>3</sub> H <sub>2</sub> ClF <sub>3</sub> ; CH <sub>2</sub> = CF <sub>2</sub> CH <sub>2</sub> F            |
| HCFO-1233zd(Z)                                                                         | 99728-16-2   | (Z)-CF <sub>3</sub> CH = CF <sub>2</sub>                                                                        |
| HFC-1234yf; HFO-1234yf                                                                 | 754-12-1     | C <sub>3</sub> H <sub>2</sub> F <sub>4</sub> ; CF <sub>3</sub> CH = CF <sub>2</sub>                             |
| HFC-1234ze(E)                                                                          | 1645-83-6    | C <sub>3</sub> H <sub>2</sub> F <sub>4</sub> ; trans-CH = CHF <sub>2</sub>                                      |
| HFC-1234ze(Z)                                                                          | 29118-25-0   | C <sub>3</sub> H <sub>2</sub> F <sub>4</sub> ; cis-CH = CHF <sub>2</sub> ; CF <sub>3</sub> CH = CF <sub>2</sub> |
| HFC-1243zf; TFP                                                                        | 677-21-4     | C <sub>3</sub> H <sub>3</sub> F <sub>3</sub> ; CF <sub>3</sub> CH <sub>2</sub> = CH <sub>2</sub>                |
| (Z)-HFC-1336                                                                           | 692-49-9     | CF <sub>3</sub> CH = CH <sub>2</sub>                                                                            |



| Name                                          | CAS No.    | Chemical                                                                             |
|-----------------------------------------------|------------|--------------------------------------------------------------------------------------|
| HFO-1336mzz(E)                                | 66711-86-2 | (E)-CF <sub>3</sub> CH = C                                                           |
| HFC-1345zfc                                   | 374-27-6   | C <sub>2</sub> F <sub>5</sub> CH = C                                                 |
| HFO-1123                                      | 359-11-5   | CHF=CF <sub>2</sub>                                                                  |
| HFO-1438ezy(E)                                | 14149-41-8 | (E)-(CF <sub>3</sub> ) <sub>2</sub> CH = C                                           |
| HFO-1447fz                                    | 355-08-8   | CF <sub>3</sub> (CF <sub>2</sub> ) <sub>2</sub> C                                    |
| Capstone 42-U                                 | 19430-93-4 | C <sub>6</sub> H <sub>3</sub> F <sub>9</sub> , CF <sub>3</sub> CH = CH <sub>2</sub>  |
| Capstone 62-U                                 | 25291-17-2 | C <sub>8</sub> H <sub>3</sub> F <sub>13</sub> , CF <sub>3</sub> CH = CH <sub>2</sub> |
| Capstone 82-U                                 | 21652-58-4 | C <sub>10</sub> H <sub>3</sub> F <sub>17</sub> , C                                   |
| (e)-1-chloro-2-fluoroethene                   | 460-16-2   | (E)-CHCl = C                                                                         |
| 3,3,3-trifluoro-2-(trifluoromethyl)prop-1-ene | 382-10-5   | (CF <sub>3</sub> ) <sub>2</sub> C = C                                                |
| NON-CYCLIC, UNSATURATED CFCs                  |            |                                                                                      |
| CFC-1112                                      | 598-88-9   | CClF=CClF                                                                            |
| CFC-1112a                                     | 79-35-6    | CCl <sub>2</sub> =CF <sub>2</sub>                                                    |
| NON-CYCLIC, UNSATURATED HALOGENATED ETHERS    |            |                                                                                      |
| PMVE; HFE-216                                 | 1187-93-5  | CF <sub>3</sub> OCF = C                                                              |
| Fluoroxene                                    | 406-90-6   | CF <sub>3</sub> CH <sub>2</sub> OC                                                   |
| Methyl-perfluoroheptene-ethers                | N/A        | CH <sub>3</sub> OC <sub>7</sub> F <sub>13</sub>                                      |
| NON-CYCLIC, UNSATURATED HALOGENATED ESTERS    |            |                                                                                      |
| Ethenyl 2,2,2-trifluoroacetate                | 433-28-3   | CF <sub>3</sub> COOCH                                                                |
| Prop-2-enyl 2,2,2-trifluoroacetate            | 383-67-5   | CF <sub>3</sub> COOCH <sub>2</sub> CH=CH <sub>2</sub>                                |
| CYCLIC, UNSATURATED HFCs AND PFCs             |            |                                                                                      |
| PFC C-1418                                    | 559-40-0   | c-C <sub>5</sub> F <sub>8</sub>                                                      |
| Hexafluorocyclobutene                         | 697-11-0   | cyc (-CF=CF CF <sub>2</sub> -)                                                       |
| 1,3,3,4,4,5-heptafluorocyclopentene           | 1892-03-1  | cyc (-CF <sub>2</sub> CF CF=CH-)                                                     |
| 1,3,3,4,4-pentafluorocyclobutene              | 374-31-2   | cyc (-CH=CF CF <sub>2</sub> -)                                                       |
| 3,3,4,4-tetrafluorocyclobutene                | 2714-38-7  | cyc (-CH=CH CF <sub>2</sub> -)                                                       |
| FLUORINATED ALDEHYDES                         |            |                                                                                      |
| 3,3,3-Trifluoro-propanal                      | 460-40-2   | CF <sub>3</sub> CH <sub>2</sub> CH                                                   |

| Name                                                                  | CAS No.     | Chemical Formula                                                     |
|-----------------------------------------------------------------------|-------------|----------------------------------------------------------------------|
| FLUORINATED KETONES                                                   |             |                                                                      |
| Novec 1230 (perfluoro (2-methyl-3-pentanone))                         | 756-13-8    | CF <sub>3</sub> CF <sub>2</sub> C(O) (CF <sub>3</sub> ) <sub>2</sub> |
| 1,1,1-trifluoropropan-2-one                                           | 421-50-1    | CF <sub>3</sub> COCH <sub>3</sub>                                    |
| 1,1,1-trifluorobutan-2-one                                            | 381-88-4    | CF <sub>3</sub> COCH <sub>2</sub> CF <sub>3</sub>                    |
| FLUOROTELOMER ALCOHOLS                                                |             |                                                                      |
| 3,3,4,4,5,5,6,6,7,7,7-Undecafluoroheptan-1-ol                         | 185689-57-0 | CF <sub>3</sub> (CF <sub>2</sub> ) <sub>4</sub> C(OH)                |
| 3,3,3-Trifluoropropan-1-ol                                            | 2240-88-2   | CF <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH                   |
| 3,3,4,4,5,5,6,6,7,7,8,8,9,9-Pentadecafluorononan-1-ol                 | 755-02-2    | CF <sub>3</sub> (CF <sub>2</sub> ) <sub>6</sub> C(OH)                |
| 3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,11,11,11-Nonadecafluoroundecan-1-ol | 87017-97-8  | CF <sub>3</sub> (CF <sub>2</sub> ) <sub>8</sub> C(OH)                |
| FLUORINATED GHGS WITH CARBON-IODINE BOND(S)                           |             |                                                                      |
| Trifluoriodomethane                                                   | 2314-97-8   | CF <sub>3</sub> I                                                    |
| REMAINING FLUORINATED GHGS WITH CHEMICAL-SPECIFIC GWPs                |             |                                                                      |
| Dibromodifluoromethane (Halon 1202)                                   | 75-61-6     | CBr <sub>2</sub> F <sub>2</sub>                                      |
| 2-Bromo-2-chloro-1,1,1-trifluoroethane (Halon-2311/Halothane)         | 151-67-7    | CHBrClCF <sub>3</sub>                                                |
| Heptafluoroisobutyronitrile                                           | 42532-60-5  | (CF <sub>3</sub> ) <sub>2</sub> CFCN                                 |

| Name              | CAS No.  | Chemical formula |
|-------------------|----------|------------------|
| Carbonyl fluoride | 353-50-4 | COF <sub>2</sub> |

| Fluorinated GHG group <sup>f</sup> | Global warming potential (100 yr.) |
|------------------------------------|------------------------------------|
|------------------------------------|------------------------------------|

DEFAULT GWPs FOR COMPOUNDS FOR WHICH CHEMICAL-SPECIFIC GWPs ARE NOT LISTED ABOVE

|                                                                                                                                                                                                                                                                                                                                                                                 |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Fully fluorinated GHGs <sup>g</sup>                                                                                                                                                                                                                                                                                                                                             | 9,200 |
| Saturated hydrofluorocarbons (HFCs) with 2 or fewer carbon-hydrogen bonds <sup>g</sup>                                                                                                                                                                                                                                                                                          | 3,000 |
| Saturated HFCs with 3 or more carbon-hydrogen bonds <sup>g</sup>                                                                                                                                                                                                                                                                                                                | 840   |
| Saturated hydrofluoroethers (HFEs) and hydrochlorofluoroethers (HCFEs) with 1 carbon-hydrogen bond <sup>g</sup>                                                                                                                                                                                                                                                                 | 6,600 |
| Saturated HFEs and HCFEs with 2 carbon-hydrogen bonds <sup>g</sup>                                                                                                                                                                                                                                                                                                              | 2,900 |
| Saturated HFEs and HCFEs with 3 or more carbon-hydrogen bonds <sup>g</sup>                                                                                                                                                                                                                                                                                                      | 320   |
| Saturated chlorofluorocarbons (CFCs) <sup>g</sup>                                                                                                                                                                                                                                                                                                                               | 4,900 |
| Fluorinated formates                                                                                                                                                                                                                                                                                                                                                            | 350   |
| Cyclic forms of the following: unsaturated perfluorocarbons (PFCs), unsaturated HFCs, unsaturated CFCs, unsaturated hydrochlorofluorocarbons (HCFCs), unsaturated bromofluorocarbons (BFCs), unsaturated bromochlorofluorocarbons (BCFCs), unsaturated hydrobromofluorocarbons (HBFCs), unsaturated hydrobromochlorofluorocarbons (HBCFCs), unsaturated halogenated ethers, and | 58    |

<sup>a</sup> The GWP for this compound was updated in the final rule published on November 29, 2013 [78 FR 71904] and effective on January 1, 2014.

<sup>b</sup> This compound was added to table A-1 in the final rule published on December 11, 2014, and effective on January 1, 2015.

<sup>c</sup> The GWP for this compound was updated in the final rule published on December 11, 2014, and effective on January 1, 2015.

<sup>d</sup> The GWP for this compound was updated in the final rule published on April 25, 2024 and effective on January 1, 2025.

<sup>e</sup> The GWP for this compound was added to table A-1 in the final rule published on April 25, 2024 and effective on January 1, 2025.

<sup>f</sup> For electronics manufacturing (as defined in § 98.90), the term “fluorinated GHGs” in the definition of each fluorinated GHG group in § 98.6 shall include fluorinated heat transfer fluids (as defined in § 98.6), whether or not they are also fluorinated GHGs.

<sup>g</sup> The GWP for this fluorinated GHG group was updated in the final rule published on April 25, 2024 and effective on January 1, 2025.

| Fluorinated GHG group <sup>f</sup>                                                                                                                                                                                                                                                                                                        | Global warming potential (100 yr.) |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| unsaturated halogenated esters <sup>g</sup>                                                                                                                                                                                                                                                                                               |                                    |
| Fluorinated acetates, carbonofluoridates, and fluorinated alcohols other than fluorotelomer alcohols <sup>g</sup>                                                                                                                                                                                                                         | 25                                 |
| Fluorinated aldehydes, fluorinated ketones, and non-cyclic forms of the following: unsaturated perfluorocarbons (PFCs), unsaturated HFCs, unsaturated CFCs, unsaturated HCFCs, unsaturated BFCs, unsaturated BCFCs, unsaturated HBFCs, unsaturated HBCFCs, unsaturated halogenated ethers and unsaturated halogenated esters <sup>g</sup> | 1                                  |
| Fluorotelomer alcohols <sup>g</sup>                                                                                                                                                                                                                                                                                                       | 1                                  |
| Fluorinated GHGs with carbon-iodine bond(s) <sup>g</sup>                                                                                                                                                                                                                                                                                  | 1                                  |
| Other fluorinated GHGs <sup>g</sup>                                                                                                                                                                                                                                                                                                       | 1,800                              |

<sup>a</sup> The GWP for this compound was updated in the final rule published on November 29, 2013 [78 FR 71904] and effective on January 1, 2014.

<sup>b</sup> This compound was added to table A-1 in the final rule published on December 11, 2014, and effective on January 1, 2015.

<sup>c</sup> The GWP for this compound was updated in the final rule published on December 11, 2014, and effective on January 1, 2015.

<sup>d</sup> The GWP for this compound was updated in the final rule published on April 25, 2024 and effective on January 1, 2025.

<sup>e</sup> The GWP for this compound was added to table A-1 in the final rule published on April 25, 2024 and effective on January 1, 2025.

<sup>f</sup> For electronics manufacturing (as defined in § 98.90), the term “fluorinated GHGs” in the definition of each fluorinated GHG group in § 98.6 shall include fluorinated heat transfer fluids (as defined in § 98.6), whether or not they are also fluorinated GHGs.

<sup>g</sup> The GWP for this fluorinated GHG group was updated in the final rule published on April 25, 2024 and effective on January 1, 2025.

[89 FR 31894, Apr. 25, 2024]

Table A-2 to Subpart A of Part 98—Units of Measure Conversions

| To convert from | To             | Multiply by                |
|-----------------|----------------|----------------------------|
| Kilograms (kg)  | Pounds (lbs)   | 2.20462                    |
| Pounds (lbs)    | Kilograms (kg) | 0.45359                    |
| Pounds (lbs)    | Metric tons    | 4.53592 × 10 <sup>-4</sup> |
| Short tons      | Pounds (lbs)   | 2,000                      |

| To convert from                 | To                                   | Multiply by                                                     |
|---------------------------------|--------------------------------------|-----------------------------------------------------------------|
| Short tons                      | Metric tons                          | 0.90718                                                         |
| Metric tons                     | Short tons                           | 1.10231                                                         |
| Metric tons                     | Kilograms (kg)                       | 1,000                                                           |
| Cubic meters (m <sup>3</sup> )  | Cubic feet (ft <sup>3</sup> )        | 35.31467                                                        |
| Cubic feet (ft <sup>3</sup> )   | Cubic meters (m <sup>3</sup> )       | 0.028317                                                        |
| Gallons (liquid, US)            | Liters (l)                           | 3.78541                                                         |
| Liters (l)                      | Gallons (liquid, US)                 | 0.26417                                                         |
| Barrels of Liquid Fuel (bbl)    | Cubic meters (m <sup>3</sup> )       | 0.15891                                                         |
| Cubic meters (m <sup>3</sup> )  | Barrels of Liquid Fuel (bbl)         | 6.289                                                           |
| Barrels of Liquid Fuel (bbl)    | Gallons (liquid, US)                 | 42                                                              |
| Gallons (liquid, US)            | Barrels of Liquid Fuel (bbl)         | 0.023810                                                        |
| Gallons (liquid, US)            | Cubic meters (m <sup>3</sup> )       | 0.0037854                                                       |
| Liters (l)                      | Cubic meters (m <sup>3</sup> )       | 0.001                                                           |
| Feet (ft)                       | Meters (m)                           | 0.3048                                                          |
| Meters (m)                      | Feet (ft)                            | 3.28084                                                         |
| Miles (mi)                      | Kilometers (km)                      | 1.60934                                                         |
| Kilometers (km)                 | Miles (mi)                           | 0.62137                                                         |
| Square feet (ft <sup>2</sup> )  | Acres                                | $2.29568 \times 10^{-5}$                                        |
| Square meters (m <sup>2</sup> ) | Acres                                | $2.47105 \times 10^{-4}$                                        |
| Square miles (mi <sup>2</sup> ) | Square kilometers (km <sup>2</sup> ) | 2.58999                                                         |
| Degrees Celsius (°C)            | Degrees Fahrenheit (°F)              | $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times \frac{5}{9}$ |
| Degrees Fahrenheit (°F)         | Degrees Celsius (°C)                 | $^{\circ}\text{F} = (^{\circ}\text{C} \times \frac{9}{5}) + 32$ |
| Degrees Celsius (°C)            | Kelvin (K)                           | $\text{K} = ^{\circ}\text{C} + 273.15$                          |
| Kelvin (K)                      | Degrees Rankine (°R)                 | 1.8                                                             |
| Joules                          | Btu                                  | $9.47817 \times 10^{-4}$                                        |
| Btu                             | MMBtu                                | $1 \times 10^{-6}$                                              |
| Pascals (Pa)                    | Inches of Mercury (in Hg)            | $2.95334 \times 10^{-4}$                                        |
| Inches of Mercury (inHg)        | Pounds per square inch (psi)         | 0.49110                                                         |
| Pounds per square inch (psi)    | Inches of Mercury (in Hg)            | 2.03625                                                         |

**Table A-3 to Subpart A of Part 98—Source Category List for § 98.2(a)(1)**

**TABLE A-3 TO SUBPART A OF PART 98—SOURCE CATEGORY LIST FOR § 98.2(a)(1)**

Source Categories <sup>a</sup> Applicable in Reporting Year 2010 and Future Years:

<sup>a</sup> Source categories are defined in each applicable subpart of this part.

Electricity generation units that report CO<sub>2</sub> mass emissions year round through 40 CFR part 75 (subpart D).

Adipic acid production (subpart E of this part).

Aluminum production (subpart F of this part).

Ammonia manufacturing (subpart G of this part).

Cement production (subpart H of this part).

HCFC-22 production (subpart O of this part).

HFC-23 destruction processes that are not collocated with a HCFC-22 production facility and that destroy more than 2.14 metric tons of HFC-23 per year (subpart O of this part).

Lime manufacturing (subpart S of this part).

Nitric acid production (subpart V of this part).

Petrochemical production (subpart X of this part).

Petroleum refineries (subpart Y of this part).

Phosphoric acid production (subpart Z of this part).

Silicon carbide production (subpart BB of this part).

Soda ash production (subpart CC of this part).

Titanium dioxide production (subpart EE of this part).

Municipal solid waste landfills that generate CH<sub>4</sub> in amounts equivalent to 25,000 metric tons CO<sub>2</sub> e or more per year, as determined according to subpart HH of this part.

Manure management systems with combined CH<sub>4</sub> and N<sub>2</sub> O emissions in amounts equivalent to 25,000 metric tons CO<sub>2</sub> e or more per year, as determined according to subpart JJ of this part.

Additional Source Categories <sup>a</sup> Applicable in Reporting Year 2011 and Future Years:

Electrical transmission and distribution equipment use at facilities where the total estimated emissions from fluorinated GHGs, as determined under § 98.301 (subpart DD of this part), are equivalent to 25,000 metric tons CO<sub>2</sub> e or more per year.

Underground coal mines liberating 36,500,000 actual cubic feet of CH<sub>4</sub> or more per year (subpart FF of this part).

Geologic sequestration of carbon dioxide (subpart RR of this part).

Injection of carbon dioxide (subpart UU of this part).

Additional Source Categories <sup>a</sup> Applicable in Reporting Year 2025 and Future Years:

Geologic sequestration of carbon dioxide with enhanced oil recovery using ISO 27916 (subpart VV of this part).

Coke calciners (subpart WW of this part).

Calcium carbide production (subpart XX of this part).

Caprolactam, glyoxal, and glyoxylic acid production (subpart YY of this part).

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<sup>a</sup> Source categories are defined in each applicable subpart of this part.

[75 FR 39760, July 12, 2010, as amended at 75 FR 74817, 75078, Dec. 1, 2010; 76 FR 73900, Nov. 29, 2011; 81 FR 89250, Dec. 9, 2016; 89 FR 31899, Apr. 25, 2024]

**Table A-4 to Subpart A of Part 98—Source Category List for § 98.2(a)(2)**

**TABLE A-4 TO SUBPART A OF PART 98—SOURCE CATEGORY LIST FOR § 98.2(a)(2)**

Source Categories <sup>a</sup> Applicable in Reporting Year 2010 and Future Years:

Ferroalloy production (subpart K of this part).  
Glass production (subpart N of this part).  
Hydrogen production (subpart P of this part).  
Iron and steel production (subpart Q of this part).  
Lead production (subpart R of this part).  
Pulp and paper manufacturing (subpart AA of this part).  
Zinc production (subpart GG of this part).

Additional Source Categories <sup>a</sup> Applicable in Reporting Year 2011 and Future Years:

Electronics manufacturing (subpart I of this part).  
Fluorinated gas production (subpart L of this part).  
Magnesium production (subpart T of this part).  
Petroleum and Natural Gas Systems (subpart W of this part).  
Industrial wastewater treatment (subpart II of this part).  
Electrical transmission and distribution equipment manufacture or refurbishment, as determined under § 98.451 (subpart SS of this part).  
Industrial waste landfills (subpart TT of this part).

Additional Source Categories <sup>a</sup> Applicable in Reporting Year 2025 and Future Years:

Ceramics manufacturing facilities, as determined under § 98.520 (subpart ZZ of this part).

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<sup>a</sup> Source categories are defined in each applicable subpart.

[75 FR 39760, July 12, 2010, as amended at 75 FR 74488, Nov. 30, 2010; 75 FR 74817, Dec. 1, 2010; 81 FR 89250, Dec. 9, 2016; 89 FR 31899, Apr. 25, 2024]

**Table A-5 to Subpart A of Part 98—Supplier Category List for § 98.2(a)(4)**

Supplier Categories <sup>a</sup> Applicable in Reporting Year 2010 and Future Years

Coal-to-liquids suppliers (subpart LL):

- (A) All producers of coal-to-liquid products.
- (B) Importers of an annual quantity of coal-to-liquid products that is equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (C) Exporters of an annual quantity of coal-to-liquid products that is equivalent to 25,000 metric tons CO<sub>2</sub> e or more.

<sup>a</sup> Suppliers are defined in each applicable subpart.

Petroleum product suppliers (subpart MM):

- (A) All petroleum refineries that distill crude oil.
- (B) Importers of an annual quantity of petroleum products and natural gas liquids that is equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (C) Exporters of an annual quantity of petroleum products and natural gas liquids that is equivalent to 25,000 metric tons CO<sub>2</sub> e or more.

Natural gas and natural gas liquids suppliers (subpart NN):

- (A) All fractionators.
- (B) Local natural gas distribution companies that deliver 460,000 thousand standard cubic feet or more of natural gas per year.

Industrial greenhouse gas suppliers (subpart OO):

- (A) All producers of industrial greenhouse gases.
- (B) Importers of industrial greenhouse gases with annual bulk imports of N<sub>2</sub> O, fluorinated GHG, and CO<sub>2</sub> that in combination are equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (C) Exporters of industrial greenhouse gases with annual bulk exports of N<sub>2</sub> O, fluorinated GHG, and CO<sub>2</sub> that in combination are equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (D) Starting with reporting year 2018, all producers of fluorinated heat transfer fluids.
- (E) Starting with reporting year 2018, importers of fluorinated heat transfer fluids with annual bulk imports of N<sub>2</sub> O, fluorinated GHG, fluorinated heat transfer fluids, and CO<sub>2</sub> that in combination are equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (F) Starting with reporting year 2018, exporters of fluorinated heat transfer fluids with annual bulk exports of N<sub>2</sub> O, fluorinated GHG, fluorinated heat transfer fluids, and CO<sub>2</sub> that in combination are equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (G) Starting with reporting year 2018, facilities that destroy 25,000 mtCO<sub>2</sub> e or more of fluorinated GHGs or fluorinated heat transfer fluids annually.

Carbon dioxide suppliers (subpart PP):

- (A) All producers of CO<sub>2</sub>.
- (B) Importers of CO<sub>2</sub> with annual bulk imports of N<sub>2</sub> O, fluorinated GHG, and CO<sub>2</sub> that in combination are equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (C) Exporters of CO<sub>2</sub> with annual bulk exports of N<sub>2</sub> O, fluorinated GHG, and CO<sub>2</sub> that in combination are equivalent to 25,000 metric tons CO<sub>2</sub> e or more.

Additional Supplier Categories Applicable <sup>a</sup> in Reporting Year 2011 and Future Years

Importers and exporters of fluorinated greenhouse gases contained in pre-charged equipment or closed-cell foams (subpart QQ):

- (A) Importers of an annual quantity of fluorinated greenhouse gases contained in pre-charged equipment or closed-cell foams that is equivalent to 25,000 metric tons CO<sub>2</sub> e or more.
- (B) Exporters of an annual quantity of fluorinated greenhouse gases contained in pre-charged equipment or closed-cell foams that is equivalent to 25,000 metric tons CO<sub>2</sub> e or more.

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<sup>a</sup> Suppliers are defined in each applicable subpart.



**Table A-6 to Subpart A of Part 98—Data Elements That Are Inputs to Emission Equations and for Which the Reporting Deadline Is March 31, 2013**

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2013<br>("All" means all data elements in the cited paragraph are not<br>required to be reported until March 31, 2013) |
|---------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C       | 98.36(d)(1)(iv)                   | All.                                                                                                                                                                                |
| C       | 98.36(d)(2)(ii)(G)                | All.                                                                                                                                                                                |
| C       | 98.36(d)(2)(iii)(G)               | All.                                                                                                                                                                                |
| C       | 98.36(e)(2)(iv)(G)                | All.                                                                                                                                                                                |
| C       | 98.36(e)(2)(viii)(A)              | All.                                                                                                                                                                                |
| C       | 98.36(e)(2)(viii)(B)              | All.                                                                                                                                                                                |
| C       | 98.36(e)(2)(viii)(C)              | All.                                                                                                                                                                                |
| C       | 98.36(e)(2)(x)(A)                 | All.                                                                                                                                                                                |
| C       | 98.36(e)(2)(xi)                   | All.                                                                                                                                                                                |
| DD      | 98.306(a)(2)                      | All.                                                                                                                                                                                |
| DD      | 98.306(a)(3)                      | All.                                                                                                                                                                                |
| DD      | 98.306(d)                         | All.                                                                                                                                                                                |
| DD      | 98.306(e)                         | All.                                                                                                                                                                                |
| DD      | 98.306(f)                         | All.                                                                                                                                                                                |
| DD      | 98.306(g)                         | All.                                                                                                                                                                                |
| DD      | 98.306(h)                         | All.                                                                                                                                                                                |
| DD      | 98.306(i)                         | All.                                                                                                                                                                                |
| DD      | 98.306(j)                         | All.                                                                                                                                                                                |
| DD      | 98.306(k)                         | All.                                                                                                                                                                                |
| DD      | 98.306(l)                         | All.                                                                                                                                                                                |
| FF      | 98.326(a)                         | All.                                                                                                                                                                                |
| FF      | 98.326(b)                         | All.                                                                                                                                                                                |
| FF      | 98.326(c)                         | All.                                                                                                                                                                                |
| FF      | 98.326(f)                         | Only quarterly volumetric flow rate.                                                                                                                                                |
| FF      | 98.326(g)                         | Only quarterly CH <sub>4</sub> concentration.                                                                                                                                       |
| FF      | 98.326(h)                         | Only weekly volumetric flow used to calculate CH <sub>4</sub> liberated from degasification systems.                                                                                |
| FF      | 98.326(j)                         | All.                                                                                                                                                                                |
| FF      | 98.326(k)                         | All.                                                                                                                                                                                |
| FF      | 98.326(o)                         | All.                                                                                                                                                                                |
| FF      | 98.326(p)                         | Only assumed destruction efficiency for the primary destruction device and assumed destruction efficiency for the backup destruction device.                                        |
| HH      | 98.346(a)                         | Only year in which landfill first accepted waste, last year the landfill accepted waste (if used as an input in Equation HH-3), capacity of                                         |

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2013<br>("All" means all data elements in the cited paragraph are not<br>required to be reported until March 31, 2013)                                                                                                                                                                                                  |
|---------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HH      | 98.346(b)                         | the landfill (if used as an input in Equation HH-3), and waste disposal quantity for each year of landfilling.<br>Only quantity of waste determined using the methods in § 98.343(a)(3)(i), quantity of waste determined using the methods in § 98.343(a)(3)(ii), population served by the landfill for each year, and the value of landfill capacity (LFC) used in the calculation. |
| HH      | 98.346(c)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| HH      | 98.346(d)(1)                      | Only degradable organic carbon (DOC) value, and fraction of DOC dissimilated (DOCF) values.                                                                                                                                                                                                                                                                                          |
| HH      | 98.346(d)(2)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| HH      | 98.346(e)                         | Only fraction of CH <sub>4</sub> in landfill gas and methane correction factor (MCF) values.                                                                                                                                                                                                                                                                                         |
| HH      | 98.346(f)                         | Only surface area associated with each cover type.                                                                                                                                                                                                                                                                                                                                   |
| HH      | 98.346(g)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| HH      | 98.346(i)(5)                      | Only annual operating hours for the destruction devices located at the landfill facility, and the destruction efficiency for the destruction devices associated with that measurement location.                                                                                                                                                                                      |
| HH      | 98.346(i)(6)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| HH      | 98.346(i)(7)                      | Only surface area specified in Table HH-3, estimated gas collection system efficiency, and annual operating hours of the gas collection system for each measurement locations.                                                                                                                                                                                                       |
| HH      | 98.346(i)(9)                      | Only CH <sub>4</sub> generation value.                                                                                                                                                                                                                                                                                                                                               |
| II      | 98.356(b)(1)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(b)(2)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(b)(3)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(b)(4)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(b)(5)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(d)(1)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(d)(7)                      | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| II      | 98.356(d)(8)                      | Only annual operating hours for the primary destruction device, annual operating hours for the backup destruction device, destruction efficiency of the primary destruction device, and destruction efficiency of the backup destruction device.                                                                                                                                     |
| SS      | 98.456(a)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| SS      | 98.456(b)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| SS      | 98.456(c)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| SS      | 98.456(d)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| SS      | 98.456(e)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |
| SS      | 98.456(f)                         | All.                                                                                                                                                                                                                                                                                                                                                                                 |

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2013<br>("All" means all data elements in the cited paragraph are not<br>required to be reported until March 31, 2013)                                                |
|---------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SS      | 98.456(g)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(h)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(i)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(j)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(m)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(n)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(o)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(q)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(r)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(s)                         | All.                                                                                                                                                                                                                               |
| SS      | 98.456(t)                         | Only for any missing data the substitute parameters used to estimate emissions in their absence.                                                                                                                                   |
| TT      | 98.466(a)(2)                      | All.                                                                                                                                                                                                                               |
| TT      | 98.466(a)(3)                      | Only last year the landfill accepted waste (for closed landfills using Equation TT-4).                                                                                                                                             |
| TT      | 98.466(a)(4)                      | Only capacity of the landfill in metric tons (for closed landfills using Equation TT-4).                                                                                                                                           |
| TT      | 98.466(b)(3)                      | Only fraction of CH <sub>4</sub> in landfill gas.                                                                                                                                                                                  |
| TT      | 98.466(b)(4)                      | Only the methane correction factor (MCF) value used in the calculations.                                                                                                                                                           |
| TT      | 98.466(c)(4)(i)                   | All.                                                                                                                                                                                                                               |
| TT      | 98.466(c)(4)(ii)                  | All.                                                                                                                                                                                                                               |
| TT      | 98.466(c)(4)(iii)                 | All.                                                                                                                                                                                                                               |
| TT      | 98.466(d)(2)                      | All.                                                                                                                                                                                                                               |
| TT      | 98.466(d)(3)                      | Only degradable organic carbon (DOC <sub>x</sub> ) value for each waste stream used in calculations.                                                                                                                               |
| TT      | 98.466(e)(2)                      | Only surface area (in square meters) at the start of the reporting year for the landfill sections that contain waste and that are associated with the selected cover type (for facilities using a landfill gas collection system). |
| TT      | 98.466(f)                         | All.                                                                                                                                                                                                                               |

[76 FR 53065, Aug. 25, 2011, as amended at 77 FR 48088, Aug. 13, 2012; 78 FR 71949, Nov. 29, 2013]

**Table A-7 to Subpart A of Part 98—Data Elements That Are Inputs to Emission Equations and for Which the Reporting Deadline Is March 31, 2015**

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2015<br>("All" means all data elements in the cited paragraph are<br>not required to be reported until March 31, 2015) |
|---------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A       | 98.3(d)(3)(v)                     | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(b)(9)(iii)                  | Only estimate of the heat input. <sup>a</sup>                                                                                                                                       |
| C       | 98.36(c)(2)(ix)                   | Only estimate of the heat input from each type of fuel listed in Table C-2. <sup>a</sup>                                                                                            |
| C       | 98.36(e)(2)(i)                    | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(ii)(A)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(ii)(C)                | Only HHV value for each calendar month in which HHV determination is required. <sup>a</sup>                                                                                         |
| C       | 98.36(e)(2)(ii)(D)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(iv)(A)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(iv)(C)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(iv)(F)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(ix)(D)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(ix)(E)                | All. <sup>a</sup>                                                                                                                                                                   |
| C       | 98.36(e)(2)(ix)(F)                | All. <sup>a</sup>                                                                                                                                                                   |
| E       | 98.56(g)                          | All.                                                                                                                                                                                |
| E       | 98.56(h)                          | All.                                                                                                                                                                                |
| E       | 98.56(j)(4)                       | All.                                                                                                                                                                                |
| E       | 98.56(j)(5)                       | All.                                                                                                                                                                                |
| E       | 98.56(j)(6)                       | All.                                                                                                                                                                                |
| E       | 98.56(l)                          | All.                                                                                                                                                                                |
| H       | 98.86(b)(11)                      | All.                                                                                                                                                                                |
| H       | 98.86(b)(13)                      | Name of raw kiln feed or raw material.                                                                                                                                              |
| O       | 98.156(d)(2)                      | All.                                                                                                                                                                                |

<sup>a</sup> Required to be reported only by: (1) Stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that contain at least one combustion unit connected to a fuel-fired electric generator owned or operated by an entity that is subject to regulation of customer billing rates by the PUC (excluding generators connected to combustion units subject to 40 CFR part 98, subpart D) and that are located at a facility for which the sum of the nameplate capacities for all such electric generators is greater than or equal to 1 megawatt electric output; and (2) stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that do not meet the criteria in (1) of this footnote that elect to report these data elements, as provided in § 98.36(a), for reporting year 2014.

<sup>b</sup> This rule citation provides an option to delay reporting of this data element for certain wildcat wells and/or delineation wells.

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2015<br>("All" means all data elements in the cited paragraph are<br>not required to be reported until March 31, 2015) |
|---------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| O       | 98.156(d)(3)                      | All.                                                                                                                                                                                |
| O       | 98.156(d)(4)                      | All.                                                                                                                                                                                |
| Q       | 98.176(f)(1)                      | All.                                                                                                                                                                                |
| W       | 98.236(c)(1)(i)                   | All.                                                                                                                                                                                |
| W       | 98.236(c)(1)(ii)                  | All.                                                                                                                                                                                |
| W       | 98.236(c)(1)(iii)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(2)(i)                   | All.                                                                                                                                                                                |
| W       | 98.236(c)(3)(i)                   | All.                                                                                                                                                                                |
| W       | 98.236(c)(3)(ii)                  | Only Calculation Methodology 2.                                                                                                                                                     |
| W       | 98.236(c)(3)(iii)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(3)(iv)                  | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(A)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(B)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(C)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(D)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(E)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(F)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(G)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(i)(H)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(4)(ii)(A)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(5)(i)(D)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(5)(ii)(C)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(6)(i)(B)                | All. <sup>b</sup>                                                                                                                                                                   |
| W       | 98.236(c)(6)(i)(D)                | All. <sup>b</sup>                                                                                                                                                                   |
| W       | 98.236(c)(6)(i)(E)                | All. <sup>b</sup>                                                                                                                                                                   |
| W       | 98.236(c)(6)(i)(F)                | All. <sup>b</sup>                                                                                                                                                                   |
| W       | 98.236(c)(6)(i)(G)                | Only the amount of natural gas required.                                                                                                                                            |

<sup>a</sup> Required to be reported only by: (1) Stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that contain at least one combustion unit connected to a fuel-fired electric generator owned or operated by an entity that is subject to regulation of customer billing rates by the PUC (excluding generators connected to combustion units subject to 40 CFR part 98, subpart D) and that are located at a facility for which the sum of the nameplate capacities for all such electric generators is greater than or equal to 1 megawatt electric output; and (2) stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that do not meet the criteria in (1) of this footnote that elect to report these data elements, as provided in § 98.36(a), for reporting year 2014.

<sup>b</sup> This rule citation provides an option to delay reporting of this data element for certain wildcat wells and/or delineation wells.

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2015<br>("All" means all data elements in the cited paragraph are<br>not required to be reported until March 31, 2015) |
|---------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W       | 98.236(c)(6)(i)(H)                | Only the amount of natural gas required.                                                                                                                                            |
| W       | 98.236(c)(6)(ii)(A)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(6)(ii)(B)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(7)(i)(A)                | Only for Equation W-14A.                                                                                                                                                            |
| W       | 98.236(c)(8)(i)(F)                | All. <sup>b</sup>                                                                                                                                                                   |
| W       | 98.236(c)(8)(i)(K)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(8)(ii)(A)               | All. <sup>b</sup>                                                                                                                                                                   |
| W       | 98.236(c)(8)(ii)(H)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(8)(iii)(A)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(8)(iii)(B)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(8)(iii)(G)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(12)(ii)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(12)(v)                  | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(i)(E)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(i)(F)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(ii)(A)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(ii)(B)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(iii)(A)             | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(iii)(B)             | All.                                                                                                                                                                                |
| W       | 98.236(c)(13)(v)(A)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(14)(i)(B)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(14)(ii)(A)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(14)(ii)(B)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(14)(iii)(A)             | All.                                                                                                                                                                                |
| W       | 98.236(c)(14)(iii)(B)             | All.                                                                                                                                                                                |
| W       | 98.236(c)(14)(v)(A)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(15)(ii)(A)              | All.                                                                                                                                                                                |

<sup>a</sup> Required to be reported only by: (1) Stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that contain at least one combustion unit connected to a fuel-fired electric generator owned or operated by an entity that is subject to regulation of customer billing rates by the PUC (excluding generators connected to combustion units subject to 40 CFR part 98, subpart D) and that are located at a facility for which the sum of the nameplate capacities for all such electric generators is greater than or equal to 1 megawatt electric output; and (2) stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that do not meet the criteria in (1) of this footnote that elect to report these data elements, as provided in § 98.36(a), for reporting year 2014.

<sup>b</sup> This rule citation provides an option to delay reporting of this data element for certain wildcat wells and/or delineation wells.

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2015<br>("All" means all data elements in the cited paragraph are<br>not required to be reported until March 31, 2015) |
|---------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W       | 98.236(c)(15)(ii)(B)              | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(viii)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(ix)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(x)                  | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(xi)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(xii)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(xiii)               | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(xiv)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(xv)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(16)(xvi)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(17)(ii)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(17)(iii)                | All.                                                                                                                                                                                |
| W       | 98.236(c)(17)(iv)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(18)(i)                  | All.                                                                                                                                                                                |
| W       | 98.236(c)(18)(ii)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(19)(iv)                 | All.                                                                                                                                                                                |
| W       | 98.236(c)(19)(vii)                | All.                                                                                                                                                                                |
| Y       | 98.256(h)(5)(i)                   | Only value of the correction.                                                                                                                                                       |
| Y       | 98.256(k)(4)                      | Only mole fraction of methane in coking gas.                                                                                                                                        |
| Y       | 98.256(n)(3)                      | All (if used in Equation Y-21 to calculate emissions from equipment leaks).                                                                                                         |
| Y       | 98.256(o)(4)(vi)                  | Only tank-specific methane composition data and gas generation rate data.                                                                                                           |
| AA      | 98.276(e)                         | All.                                                                                                                                                                                |
| CC      | 98.296(b)(10)(i)                  | All.                                                                                                                                                                                |
| CC      | 98.296(b)(10)(ii)                 | All.                                                                                                                                                                                |
| CC      | 98.296(b)(10)(iii)                | All.                                                                                                                                                                                |

<sup>a</sup> Required to be reported only by: (1) Stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that contain at least one combustion unit connected to a fuel-fired electric generator owned or operated by an entity that is subject to regulation of customer billing rates by the PUC (excluding generators connected to combustion units subject to 40 CFR part 98, subpart D) and that are located at a facility for which the sum of the nameplate capacities for all such electric generators is greater than or equal to 1 megawatt electric output; and (2) stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that do not meet the criteria in (1) of this footnote that elect to report these data elements, as provided in § 98.36(a), for reporting year 2014.

<sup>b</sup> This rule citation provides an option to delay reporting of this data element for certain wildcat wells and/or delineation wells.

| Subpart | Rule citation<br>(40 CFR part 98) | Specific data elements for which reporting date is March 31, 2015<br>("All" means all data elements in the cited paragraph are<br>not required to be reported until March 31, 2015) |
|---------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CC      | 98.296(b)(10)(iv)                 | All.                                                                                                                                                                                |
| CC      | 98.296(b)(10)(v)                  | All.                                                                                                                                                                                |
| CC      | 98.296(b)(10)(vi)                 | All.                                                                                                                                                                                |
| II      | 98.356(d)(2)                      | All (if conducting weekly sampling).                                                                                                                                                |
| II      | 98.356(d)(3)                      | All (if conducting weekly sampling).                                                                                                                                                |
| II      | 98.356(d)(4)                      | Only weekly average temperature (if conducting weekly sampling).                                                                                                                    |
| II      | 98.356(d)(5)                      | Only weekly average moisture content (if conducting weekly sampling).                                                                                                               |
| II      | 98.356(d)(6)                      | Only weekly average pressure (if conducting weekly sampling).                                                                                                                       |

<sup>a</sup> Required to be reported only by: (1) Stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that contain at least one combustion unit connected to a fuel-fired electric generator owned or operated by an entity that is subject to regulation of customer billing rates by the PUC (excluding generators connected to combustion units subject to 40 CFR part 98, subpart D) and that are located at a facility for which the sum of the nameplate capacities for all such electric generators is greater than or equal to 1 megawatt electric output; and (2) stationary fuel combustion sources (e.g., individual units, aggregations of units, common pipes, or common stacks) subject to subpart C of this part that do not meet the criteria in (1) of this footnote that elect to report these data elements, as provided in § 98.36(a), for reporting year 2014.

<sup>b</sup> This rule citation provides an option to delay reporting of this data element for certain wildcat wells and/or delineation wells.

[79 FR 73783, Dec. 11, 2014]

## Subpart B [Reserved]

## Subpart C—General Stationary Fuel Combustion Sources

### § 98.30 Definition of the source category.

- (a) Stationary fuel combustion sources are devices that combust solid, liquid, or gaseous fuel, generally for the purposes of producing electricity, generating steam, or providing useful heat or energy for industrial, commercial, or institutional use, or reducing the volume of waste by removing combustible matter. Stationary fuel combustion sources include, but are not limited to, boilers, simple and combined-cycle combustion turbines, engines, incinerators, and process heaters.
- (b) This source category does not include:
  - (1) Portable equipment, as defined in § 98.6.
  - (2) Emergency generators and emergency equipment, as defined in § 98.6.
  - (3) Irrigation pumps at agricultural operations.



- (4) Flares, unless otherwise required by provisions of another subpart of this part to use methodologies in this subpart.
- (5) Electricity generating units that are subject to subpart D of this part.
- (c) For a unit that combusts hazardous waste (as defined in § 261.3 of this chapter), reporting of GHG emissions is not required unless either of the following conditions apply:
  - (1) Continuous emission monitors (CEMS) are used to quantify CO<sub>2</sub> mass emissions.
  - (2) Any fuel listed in Table C-1 of this subpart is also combusted in the unit. In this case, report GHG emissions from combustion of all fuels listed in Table C-1 of this subpart.
- (d) You are not required to report GHG emissions from pilot lights. A pilot light is a small auxiliary flame that ignites the burner of a combustion device when the control valve opens.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79140, Dec. 17, 2010]

### § 98.31 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains one or more stationary fuel combustion sources and the facility meets the applicability requirements of either §§ 98.2(a)(1), 98.2(a)(2), or 98.2(a)(3).

### § 98.32 GHGs to report.

You must report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O mass emissions from each stationary fuel combustion unit, except as otherwise indicated in this subpart.

[75 FR 79140, Dec. 17, 2010]

### § 98.33 Calculating GHG emissions.

You must calculate CO<sub>2</sub> emissions according to paragraph (a) of this section, and calculate CH<sub>4</sub> and N<sub>2</sub>O emissions according to paragraph (c) of this section.

- (a) **CO<sub>2</sub> emissions from fuel combustion.** Calculate CO<sub>2</sub> mass emissions by using one of the four calculation methodologies in paragraphs (a)(1) through (a)(4) of this section, subject to the applicable conditions, requirements, and restrictions set forth in paragraph (b) of this section. Alternatively, for units that meet the conditions of paragraph (a)(5) of this section, you may use CO<sub>2</sub> mass emissions calculation methods from part 75 of this chapter, as described in paragraph (a)(5) of this section. For units that combust both biomass and fossil fuels, you must calculate and report CO<sub>2</sub> emissions from the combustion of biomass separately using the methods in paragraph (e) of this section, except as otherwise provided in paragraphs (a)(5)(iv) and (e) of this section and in § 98.36(d).
  - (1) **Tier 1 Calculation Methodology.** Calculate the annual CO<sub>2</sub> mass emissions for each type of fuel by using Equation C-1, C-1a, or C-1b of this section (as applicable).
    - (i) Use Equation C-1 except when natural gas billing records are used to quantify fuel usage and gas consumption is expressed in units of therms or million Btu. In that case, use Equation C-1a or C-1b, as applicable.

$$CO_2 = 1 \times 10^{-3} * Fuel * HHV * EF \quad (Eq. C-1)$$

where:

$CO_2$  = Annual  $CO_2$  mass emissions for the specific fuel type (metric tons).

Fuel = Mass or volume of fuel combusted per year, from company records as defined in § 98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel).

HHV = Default high heat value of the fuel, from Table C-1 of this subpart (mmBtu per mass or mmBtu per volume, as applicable).

EF = Fuel-specific default  $CO_2$  emission factor, from Table C-1 of this subpart (kg  $CO_2$ /mmBtu).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (ii) If natural gas consumption is obtained from billing records and fuel usage is expressed in therms, use Equation C-1a.

$$CO_2 = 1 \times 10^{-3} [0.1 * Gas * EF] \quad (Eq. C-1a)$$

where:

$CO_2$  = Annual  $CO_2$  mass emissions from natural gas combustion (metric tons).

Gas = Annual natural gas usage, from billing records (therms).

EF = Fuel-specific default  $CO_2$  emission factor for natural gas, from Table C-1 of this subpart (kg  $CO_2$ /mmBtu).

0.1 = Conversion factor from therms to mmBtu

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (iii) If natural gas consumption is obtained from billing records and fuel usage is expressed in mmBtu, use Equation C-1b.

$$CO_2 = 1 \times 10^{-3} * Gas * EF \quad (Eq. C-1b)$$

where:

$CO_2$  = Annual  $CO_2$  mass emissions from natural gas combustion (metric tons).

Gas = Annual natural gas usage, from billing records (mmBtu).

EF = Fuel-specific default  $CO_2$  emission factor for natural gas, from Table C-1 of this subpart (kg  $CO_2$ /mmBtu).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

(2) **Tier 2 Calculation Methodology.** Calculate the annual CO<sub>2</sub> mass emissions for each type of fuel by using either Equation C-2a or C-2c of this section, as appropriate.

(i) Equation C-2a of this section applies to any type of fuel listed in Table C-1 of the subpart, except for municipal solid waste (MSW). For MSW combustion, use Equation C-2c of this section.

$$CO_2 = 1 \times 10^{-3} \cdot Fuel \cdot HHV \cdot EF \quad (\text{Eq. C-2a})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions for a specific fuel type (metric tons).

Fuel = Mass or volume of the fuel combusted during the year, from company records as defined in § 98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel).

HHV = Annual average high heat value of the fuel (mmBtu per mass or volume). The average HHV shall be calculated according to the requirements of paragraph (a)(2)(ii) of this section.

EF = Fuel-specific default CO<sub>2</sub> emission factor, from Table C-1 of this subpart (kg CO<sub>2</sub>/mmBtu).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

(ii) The minimum required sampling frequency for determining the annual average HHV (e.g., monthly, quarterly, semi-annually, or by lot) is specified in § 98.34. The method for computing the annual average HHV is a function of unit size and how frequently you perform or receive from the fuel supplier the results of fuel sampling for HHV. The method is specified in paragraph (a)(2)(ii)(A) or (a)(2)(ii)(B) of this section, as applicable.

(A) If the results of fuel sampling are received monthly or more frequently, then for each unit with a maximum rated heat input capacity greater than or equal to 100 mmBtu/hr (or for a group of units that includes at least one unit of that size), the annual average HHV shall be calculated using Equation C-2b of this section. If multiple HHV determinations are made in any month, average the values for the month arithmetically.

$$(HHV)_{\text{annual}} = \frac{\sum_{i=1}^n (HHV)_i \cdot (Fuel)_i}{\sum_{i=1}^n (Fuel)_i} \quad (\text{Eq. C-2b})$$

Where:

(HHV)<sub>annual</sub> = Weighted annual average high heat value of the fuel (mmBtu per mass or volume). >

$(HHV)_i$  = Measured high heat value of the fuel, for sample period "i" (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (mmBtu per mass or volume).

$(Fuel)_i$  = Mass or volume of the fuel combusted during the sample period "i," (e.g., monthly, quarterly, semi-annually, or by lot) from company records (express mass in short tons for solid fuel, volume in standard cubic feet (e.g., for gaseous fuel, and volume in gallons for liquid fuel).

n = Number of sample periods in the year.

(B) If the results of fuel sampling are received less frequently than monthly, or, for a unit with a maximum rated heat input capacity less than 100 mmBtu/hr (or a group of such units) regardless of the HHV sampling frequency, the annual average HHV shall either be computed according to paragraph (a)(2)(ii)(A) of this section or as the arithmetic average HHV for all values for the year (including valid samples and substitute data values under § 98.35).

(iii) For units that combust municipal solid waste (MSW) and that produce steam, use Equation C-2c of this section. Equation C-2c of this section may also be used for any other solid fuel listed in Table C-1 of this subpart provided that steam is generated by the unit.

$$CO_2 = 1 \times 10^{-3} \text{ Steam} \cdot B \cdot EF \quad (\text{Eq. C-2c})$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions from MSW or solid fuel combustion (metric tons).

Steam = Total mass of steam generated by MSW or solid fuel combustion during the reporting year (lb steam).

B = Ratio of the boiler's maximum rated heat input capacity to its design rated steam output capacity (mmBtu/lb steam).

EF = Fuel-specific default  $CO_2$  emission factor, from Table C-1 of this subpart (kg  $CO_2$ /mmBtu).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

(3) **Tier 3 Calculation Methodology.** Calculate the annual  $CO_2$  mass emissions for each fuel by using either Equation C3, C4, or C5 of this section, as appropriate.

(i) For a solid fuel, use Equation C-3 of this section.

$$CO_2 = \frac{44}{12} \cdot Fuel \cdot CC \cdot 0.91 \quad (\text{Eq. C-3})$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions from the combustion of the specific solid fuel (metric tons).

Fuel = Annual mass of the solid fuel combusted, from company records as defined in § 98.6 (short tons).

CC = Annual average carbon content of the solid fuel (percent by weight, expressed as a decimal fraction, e.g., 95% = 0.95). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.91 = Conversion factor from short tons to metric tons.

(ii) For a liquid fuel, use Equation C-4 of this section.

$$\text{CO}_2 = \frac{44}{12} * \text{Fuel} * \text{CC} * 0.001 \quad (\text{Eq. C-4})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from the combustion of the specific liquid fuel (metric tons).

Fuel = Annual volume of the liquid fuel combusted (gallons). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to § 98.3(i). Fuel billing meters may be used for this purpose. Tank drop measurements may also be used.

CC = Annual average carbon content of the liquid fuel (kg C per gallon of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.001 = Conversion factor from kg to metric tons.

(iii) For a gaseous fuel, use equation C-5 to this section.

$$\text{CO}_2 = \frac{44}{12} * \text{Fuel} * \text{CC} * \frac{\text{MW}}{\text{MVC}} * 0.001$$

(Eq. C-5)

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from combustion of the specific gaseous fuel (metric tons).

Fuel = Annual volume of the gaseous fuel combusted (scf). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to § 98.3(i). Fuel billing meters may be used for this purpose.

CC = Annual average carbon content of the gaseous fuel (kg C per kg of fuel). The annual average carbon content shall be determined using the procedures specified in paragraphs (a)(3)(iii)(A)(1) and (2) of this section.

MW = Annual average molecular weight of the gaseous fuel (kg per kg-mole). The annual average molecular weight shall be determined using the procedures specified in paragraphs (a)(3)(iii)(B)(1) and (2) of this section.

MVC = Molar volume conversion factor at standard conditions, as defined in § 98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.001 = Conversion factor from kg to metric tons.

(A) The minimum required sampling frequency for determining the annual average carbon content (e.g., monthly, quarterly, semi-annually, or by lot) is specified in § 98.34. The method for computing the annual average carbon content for equation C-5 to this section is a function of unit size and how frequently you perform or receive from the fuel supplier the results of fuel sampling for carbon content. The methods are specified in paragraphs (a)(3)(iii)(A)(1) and (2) of this section, as applicable.

(1) If the results of fuel sampling are received monthly or more frequently, then for each unit with a maximum rated heat input capacity greater than or equal to 100 mmBtu/hr (or for a group of units that includes at least one unit of that size), the annual average carbon content for equation C-5 shall be calculated using equation C-5A to this section. If multiple carbon content determinations are made in any month, average the values for the month arithmetically.

$$(CC)_{\text{annual}} = \frac{\sum_{i=1}^n (CC)_i * (Fuel)_i * (MW)_i / MWC}{\sum_{i=1}^n (Fuel)_i * (MW)_i / MVC}$$

(Eq. C-5A)

Where:

(CC)<sub>annual</sub> = Weighted annual average carbon content of the fuel (kg C per kg of fuel).

(CC)<sub>i</sub> = Measured carbon content of the fuel, for sample period "i" (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (kg C per kg of fuel).

(Fuel)<sub>i</sub> = Volume of the fuel (scf) combusted during the sample period "i" (e.g., monthly, quarterly, semi-annually, or by lot) from company records.

(MW)<sub>i</sub> = Measured molecular weight of the fuel, for sample period "i" (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (kg per kg-mole).

MVC = Molar volume conversion factor at standard conditions, as defined in § 98.6. Use 849.5 scf per kg-mole if you select 68 °F as standard temperature and 836.6 scf per kg-mole if you select 60 °F as standard temperature.

n = Number of sample periods in the year.

(2) If the results of fuel sampling are received less frequently than monthly, or, for a unit with a maximum rated heat input capacity less than 100 mmBtu/hr (or a group of such units) regardless of the carbon content sampling frequency, the annual average carbon content for equation C-5 shall either be computed according to paragraph (a)(3)(iii)(A)(1) of this section or as the arithmetic average carbon content for all values for the year (including valid samples and substitute data values under § 98.35).

(B) The minimum required sampling frequency for determining the annual average molecular weight (e.g., monthly, quarterly, semi-annually, or by lot) is specified in § 98.34. The method for computing the annual average molecular weight for equation C-5 is a function of unit size and how frequently you perform or receive from the fuel supplier the results of fuel sampling for molecular weight. The methods are specified in paragraphs (a)(3)(iii)(B)(1) and (2) of this section, as applicable.

(1) If the results of fuel sampling are received monthly or more frequently, then for each unit with a maximum rated heat input capacity greater than or equal to 100 mmBtu/hr (or for a group of units that includes at least one unit of that size), the annual average molecular weight for equation C-5 shall be calculated using equation C-5B to this section. If multiple molecular weight determinations are made in any month, average the values for the month arithmetically.

$$(MW)_{\text{annual}} = \frac{\sum_{i=1}^n (MW)_i * (Fuel)_i / MVC}{\sum_{i=1}^n (Fuel)_i / MVC}$$

(Eq. C-5B)

Where:

(MW)<sub>annual</sub> = Weighted annual average molecular weight of the fuel (kg per kg-mole).

(MW)<sub>i</sub> = Measured molecular weight of the fuel, for sample period "i" (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (kg per kg-mole).

(Fuel)<sub>i</sub> = Volume of the fuel (scf) combusted during the sample period "i" (e.g., monthly, quarterly, semi-annually, or by lot) from company records.

MVC = Molar volume conversion factor at standard conditions, as defined in § 98.6. Use 849.5 scf per kg-mole if you select 68 °F as standard temperature and 836.6 scf per kg-mole if you select 60 °F as standard temperature.

n = Number of sample periods in the year.

- (2) If the results of fuel sampling are received less frequently than monthly, or, for a unit with a maximum rated heat input capacity less than 100 mmBtu/hr (or a group of such units) regardless of the molecular weight sampling frequency, the annual average molecular weight for equation C-5 shall either be computed according to paragraph (a)(3)(iii)(B)(1) of this section or as the arithmetic average molecular weight for all values for the year (including valid samples and substitute data values under § 98.35).
- (iv) Fuel flow meters that measure mass flow rates may be used for liquid or gaseous fuels, provided that the fuel density is used to convert the readings to volumetric flow rates. The density shall be measured at the same frequency as the carbon content. You must measure the density using one of the following appropriate methods. You may use a method published by a consensus-based standards organization, if such a method exists, or you may use industry standard practice. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA), 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>). The method(s) used shall be documented in the GHG Monitoring Plan required under § 98.3(g)(5).
- (v) The following default density values may be used for fuel oil, in lieu of using the methods in paragraph (a)(3)(iv) of this section: 6.8 lb/gal for No. 1 oil; 7.2 lb/gal for No. 2 oil; 8.1 lb/gal for No. 6 oil.
- (4) **Tier 4 Calculation Methodology.** Calculate the annual CO<sub>2</sub> mass emissions from all fuels combusted in a unit, by using quality-assured data from continuous emission monitoring systems (CEMS).
  - (i) This methodology requires a CO<sub>2</sub> concentration monitor and a stack gas volumetric flow rate monitor, except as otherwise provided in paragraph (a)(4)(iv) of this section. Hourly measurements of CO<sub>2</sub> concentration and stack gas flow rate are converted to CO<sub>2</sub> mass emission rates in metric tons per hour.
  - (ii) When the CO<sub>2</sub> concentration is measured on a wet basis, Equation C-6 of this section is used to calculate the hourly CO<sub>2</sub> emission rates:

$$CO_2 = 5.18 \times 10^{-7} \cdot C_{CO_2} \cdot Q \quad (\text{Eq. C-6})$$

Where:

CO<sub>2</sub> = CO<sub>2</sub> mass emission rate (metric tons/hr).

C<sub>CO2</sub> = Hourly average CO<sub>2</sub> concentration (% CO<sub>2</sub>).



Q = Hourly average stack gas volumetric flow rate (scfh).

$5.18 \times 10^{-7}$  = Conversion factor (metric tons/scf/% CO<sub>2</sub>).

- (iii) If the CO<sub>2</sub> concentration is measured on a dry basis, a correction for the stack gas moisture content is required. You shall either continuously monitor the stack gas moisture content using a method described in § 75.11(b)(2) of this chapter or use an appropriate default moisture percentage. For coal, wood, and natural gas combustion, you may use the default moisture values specified in § 75.11(b)(1) of this chapter. Alternatively, for any type of fuel, you may determine an appropriate site-specific default moisture value (or values), using measurements made with EPA Method 4—Determination Of Moisture Content In Stack Gases, in appendix A-3 to part 60 of this chapter. Moisture data from the relative accuracy test audit (RATA) of a CEMS may be used for this purpose. If this option is selected, the site-specific moisture default value(s) must represent the fuel(s) or fuel blends that are combusted in the unit during normal, stable operation, and must account for any distinct difference(s) in the stack gas moisture content associated with different process operating conditions. For each site-specific default moisture percentage, at least nine Method 4 runs are required, except where the option to use moisture data from a RATA is selected, and the applicable regulation allows a single moisture determination to represent two or more RATA runs. In that case, you may base the site-specific moisture percentage on the number of moisture runs allowed by the RATA regulation. Calculate each site-specific default moisture value by taking the arithmetic average of the Method 4 runs. Each site-specific moisture default value shall be updated whenever the owner or operator believes the current value is non-representative, due to changes in unit or process operation, but in any event no less frequently than annually. Use the updated moisture value in the subsequent CO<sub>2</sub> emissions calculations. For each unit operating hour, a moisture correction must be applied to Equation C-6 of this section as follows:

$$CO_2^* = CO_2 \left( \frac{100 - \%H_2O}{100} \right) \quad (\text{Eq. C-7})$$

where:

CO<sub>2</sub>\* = Hourly CO<sub>2</sub> mass emission rate, corrected for moisture (metric tons/hr).

CO<sub>2</sub> = Hourly CO<sub>2</sub> mass emission rate from Equation C-6 of this section, uncorrected (metric tons/hr).

%H<sub>2</sub>O = Hourly moisture percentage in the stack gas (measured or default value, as appropriate).

- (iv) An oxygen (O<sub>2</sub>) concentration monitor may be used in lieu of a CO<sub>2</sub> concentration monitor to determine the hourly CO<sub>2</sub> concentrations, in accordance with Equation F-14a or F-14b (as applicable) in appendix F to part 75 of this chapter, if the effluent gas stream monitored by the CEMS consists solely of combustion products (i.e., no process CO<sub>2</sub> emissions or CO<sub>2</sub> emissions from sorbent are mixed with the combustion products) and if only fuels that are listed in Table 1 in section 3.3.5 of appendix F to part 75 of this chapter are combusted in the unit. If the O<sub>2</sub> monitoring option is selected, the F-factors used in Equations F-14a and F-14b

shall be determined according to section 3.3.5 or section 3.3.6 of appendix F to part 75 of this chapter, as applicable. If Equation F-14b is used, the hourly moisture percentage in the stack gas shall be determined in accordance with paragraph (a)(4)(iii) of this section.

- (v) Each hourly CO<sub>2</sub> mass emission rate from Equation C-6 or C-7 of this section is multiplied by the operating time to convert it from metric tons per hour to metric tons. The operating time is the fraction of the hour during which fuel is combusted (e.g., the unit operating time is 1.0 if the unit operates for the whole hour and is 0.5 if the unit operates for 30 minutes in the hour). For common stack configurations, the operating time is the fraction of the hour during which effluent gases flow through the common stack.
- (vi) The hourly CO<sub>2</sub> mass emissions are then summed over each calendar quarter and the quarterly totals are summed to determine the annual CO<sub>2</sub> mass emissions.
- (vii) If both biomass and fossil fuel are combusted during the year, determine and report the biogenic CO<sub>2</sub> mass emissions separately, as described in paragraph (e) of this section.
- (viii) If a portion of the flue gases generated by a unit subject to Tier 4 (e.g., a slip stream) is continuously diverted from the main flue gas exhaust system for the purpose of heat recovery or some other similar process, and then exhausts through a stack that is not equipped with the continuous emission monitors to measure CO<sub>2</sub> mass emissions, CO<sub>2</sub> emissions shall be determined as follows:
  - (A) At least once a year, use EPA Methods 2 and 3A, and (if necessary) Method 4 in appendices A-2 and A-3 to part 60 of this chapter to perform emissions testing at a set point that best represents normal, stable process operating conditions. A minimum of three one-hour Method 3A tests are required, to determine the CO<sub>2</sub> concentration. A Method 2 test shall be performed during each Method 3A run, to determine the stack gas volumetric flow rate. If moisture correction is necessary, a Method 4 run shall also be performed during each Method 3A run. Important parametric information related to the stack gas flow rate (e.g., damper positions, fan settings, etc.) shall also be recorded during the test.
  - (B) Calculate a CO<sub>2</sub> mass emission rate (in metric tons/hr) from the stack test data, using a version of Equation C-6 in paragraph (a)(4)(ii) of this section, modified as follows. In the Equation C-6 nomenclature, replace the words "Hourly average" in the definitions of "C<sub>CO2</sub>" and "Q" with the words "3-run average". Substitute the arithmetic average values of CO<sub>2</sub> concentration and stack gas flow rate from the emission testing into modified Equation C-6. If CO<sub>2</sub> is measured on a dry basis, a moisture correction of the calculated CO<sub>2</sub> mass emission rate is required. Use Equation C-7 in paragraph (a)(4)(ii) of this section to make this correction; replace the word "Hourly" with the words "3-run average" in the equation nomenclature.
  - (C) The results of each annual stack test shall be used in the GHG emissions calculations for the year of the test.
  - (D) If, for the majority of the operating hours during the year, the diverted stream is withdrawn at a steady rate at or near the tested set point (as evidenced by fan and damper settings and/or other parameters), you may use the calculated CO<sub>2</sub> mass emission rate from paragraph (a)(4)(viii)(B) of this section to estimate the CO<sub>2</sub> mass emissions for all

operating hours in which flue gas is diverted from the main exhaust system. Otherwise, you must account for the variation in the flow rate of the diverted stream, as described in paragraph (c)(4)(viii)(E) of this section.

- (E) If the flow rate of the diverted stream varies significantly throughout the year, except as provided below, repeat the stack test and emission rate calculation procedures described in paragraphs (c)(4)(viii)(A) and (c)(4)(viii)(B) of this section at a minimum of two more set points across the range of typical operating conditions to develop a correlation between CO<sub>2</sub> mass emission rate and the parametric data. If additional testing is not feasible, use the following approach to develop the necessary correlation. Assume that the average CO<sub>2</sub> concentration obtained in the annual stack test is the same at all operating set points. Then, beginning with the measured flow rate from the stack test and the associated parametric data, perform an engineering analysis to estimate the stack gas flow rate at two or more additional set points. Calculate the CO<sub>2</sub> mass emission rate at each set point.
  - (F) Calculate the annual CO<sub>2</sub> mass emissions for the diverted stream as follows. For a steady-state process, multiply the number of hours in which flue gas was diverted from the main exhaust system by the CO<sub>2</sub> mass emission rate from the stack test. Otherwise, using the best available information and engineering judgment, apply the most representative CO<sub>2</sub> mass emission rate from the correlation in paragraph (c)(4)(viii)(E) of this section to determine the CO<sub>2</sub> mass emissions for each hour in which flue gas was diverted, and sum the results. To simplify the calculations, you may count partial operating hours as full hours.
  - (G) Finally, add the CO<sub>2</sub> mass emissions from paragraph (c)(4)(viii)(F) of this section to the annual CO<sub>2</sub> mass emissions measured by the CEMS at the main stack. Report this sum as the total annual CO<sub>2</sub> mass emissions for the unit.
  - (H) The exact method and procedures used to estimate the CO<sub>2</sub> mass emissions for the diverted portion of the flue gas exhaust stream shall be documented in the Monitoring Plan required under § 98.3(g)(5).
- (5) **Alternative methods for certain units subject to Part 75 of this chapter.** Certain units that are not subject to subpart D of this part and that report data to EPA according to part 75 of this chapter may qualify to use the alternative methods in this paragraph (a)(5), in lieu of using any of the four calculation methodology tiers.
- (i) For a unit that combusts only natural gas and/or fuel oil, is not subject to subpart D of this part, monitors and reports heat input data year-round according to appendix D to part 75 of this chapter, but is not required by the applicable part 75 program to report CO<sub>2</sub> mass emissions data, calculate the annual CO<sub>2</sub> mass emissions for the purposes of this part as follows:
    - (A) Use the hourly heat input data from appendix D to part 75 of this chapter, together with Equation G-4 in appendix G to part 75 of this chapter to determine the hourly CO<sub>2</sub> mass emission rates, in units of tons/hr;
    - (B) Use Equations F-12 and F-13 in appendix F to part 75 of this chapter to calculate the quarterly and cumulative annual CO<sub>2</sub> mass emissions, respectively, in units of short tons; and

- (C) Divide the cumulative annual CO<sub>2</sub> mass emissions value by 1.1023 to convert it to metric tons.
- (ii) For a unit that combusts only natural gas and/or fuel oil, is not subject to subpart D of this part, monitors and reports heat input data year-round according to § 75.19 of this chapter but is not required by the applicable part 75 program to report CO<sub>2</sub> mass emissions data, calculate the annual CO<sub>2</sub> mass emissions for the purposes of this part as follows:
  - (A) Calculate the hourly CO<sub>2</sub> mass emissions, in units of short tons, using Equation LM-11 in § 75.19(c)(4)(iii) of this chapter.
  - (B) Sum the hourly CO<sub>2</sub> mass emissions values over the entire reporting year to obtain the cumulative annual CO<sub>2</sub> mass emissions, in units of short tons.
  - (C) Divide the cumulative annual CO<sub>2</sub> mass emissions value by 1.1023 to convert it to metric tons.
- (iii) For a unit that is not subject to subpart D of this part, uses flow rate and CO<sub>2</sub> (or O<sub>2</sub>) CEMS to report heat input data year-round according to part 75 of this chapter, but is not required by the applicable part 75 program to report CO<sub>2</sub> mass emissions data, calculate the annual CO<sub>2</sub> mass emissions as follows:
  - (A) Use Equation F-11 or F-2 (as applicable) in appendix F to part 75 of this chapter to calculate the hourly CO<sub>2</sub> mass emission rates from the CEMS data. If an O<sub>2</sub> monitor is used, convert the hourly average O<sub>2</sub> readings to CO<sub>2</sub> using Equation F-14a or F-14b in appendix F to part 75 of this chapter (as applicable), before applying Equation F-11 or F-2.
  - (B) Use Equations F-12 and F-13 in appendix F to part 75 of this chapter to calculate the quarterly and cumulative annual CO<sub>2</sub> mass emissions, respectively, in units of short tons.
  - (C) Divide the cumulative annual CO<sub>2</sub> mass emissions value by 1.1023 to convert it to metric tons.
- (iv) For units that qualify to use the alternative CO<sub>2</sub> emissions calculation methods in paragraphs (a)(5)(i) through (a)(5)(iii) of this section, if both biomass and fossil fuel are combusted during the year, separate calculation and reporting of the biogenic CO<sub>2</sub> mass emissions (as described in paragraph (e) of this section) is optional, only for the 2010 reporting year, as provided in § 98.3(c)(12).
- (b) **Use of the four tiers.** Use of the four tiers of CO<sub>2</sub> emissions calculation methodologies described in paragraph (a) of this section is subject to the following conditions, requirements, and restrictions:
  - (1) The Tier 1 Calculation Methodology:
    - (i) May be used for any fuel listed in Table C-1 of this subpart that is combusted in a unit with a maximum rated heat input capacity of 250 mmBtu/hr or less.
    - (ii) May be used for MSW in a unit of any size that does not produce steam, if the use of Tier 4 is not required.
    - (iii) May be used for solid, gaseous, or liquid biomass fuels in a unit of any size provided that the fuel is listed in Table C-1 of this subpart.

- (iv) May not be used if you routinely perform fuel sampling and analysis for the fuel high heat value (HHV) or routinely receive the results of HHV sampling and analysis from the fuel supplier at the minimum frequency specified in § 98.34(a), or at a greater frequency. In such cases, Tier 2 shall be used. This restriction does not apply to paragraphs (b)(1)(ii), (b)(1)(v), (b)(1)(vi), and (b)(1)(vii) of this section.
  - (v) May be used for natural gas combustion in a unit of any size, in cases where the annual natural gas consumption is obtained from fuel billing records in units of therms or mmBtu.
  - (vi) May be used for MSW combustion in a small, batch incinerator that burns no more than 1,000 tons per year of MSW.
  - (vii) May be used for the combustion of MSW and/or tires in a unit, provided that no more than 10 percent of the unit's annual heat input is derived from those fuels, combined.
  - (viii) May be used for the combustion of a fuel listed in Table C-1 if the fuel is combusted in a unit with a maximum rated heat input capacity greater than 250 mmBtu/hr (or, pursuant to § 98.36(c)(3), in a group of units served by a common supply pipe, having at least one unit with a maximum rated heat input capacity greater than 250 mmBtu/hr), provided that both of the following conditions apply:
    - (A) The use of Tier 4 is not required.
    - (B) The fuel provides less than 10 percent of the annual heat input to the unit, or if § 98.36(c)(3) applies, to the group of units served by a common supply pipe.
- (2) The Tier 2 Calculation Methodology:
- (i) May be used for the combustion of any type of fuel in a unit with a maximum rated heat input capacity of 250 mmBtu/hr or less provided that the fuel is listed in Table C-1 of this subpart.
  - (ii) May be used in a unit with a maximum rated heat input capacity greater than 250 mmBtu/hr for the combustion of natural gas and/or distillate fuel oil.
  - (iii) May be used for MSW in a unit of any size that produces steam, if the use of Tier 4 is not required.
- (3) The Tier 3 Calculation Methodology:
- (i) May be used for a unit of any size that combusts any type of fuel listed in Table C-1 of this subpart (except for MSW), unless the use of Tier 4 is required.
  - (ii) Shall be used for a unit with a maximum rated heat input capacity greater than 250 mmBtu/hr that combusts any type of fuel listed in Table C-1 of this subpart (except MSW), unless either of the following conditions apply:
    - (A) The use of Tier 1 or 2 is permitted, as described in paragraphs (b)(1)(iii), (b)(1)(v), (b)(1)(viii), and (b)(2)(ii) of this section.
    - (B) The use of Tier 4 is required.

- (iii) Shall be used for a fuel not listed in Table C-1 of this subpart if the fuel is combusted in a unit with a maximum rated heat input capacity greater than 250 mmBtu/hr (or, pursuant to § 98.36(c)(3), in a group of units served by a common supply pipe, having at least one unit with a maximum rated heat input capacity greater than 250 mmBtu/hr), provided that both of the following conditions apply:
  - (A) The use of Tier 4 is not required.
  - (B) The fuel provides 10% or more of the annual heat input to the unit or, if § 98.36(c)(3) applies, to the group of units served by a common supply pipe.
- (iv) Shall be used when specified in another applicable subpart of this part, regardless of unit size.
- (4) The Tier 4 Calculation Methodology:
  - (i) May be used for a unit of any size, combusting any type of fuel. Tier 4 may also be used for any group of stationary fuel combustion units, process units, or manufacturing units that share a common stack or duct.
  - (ii) Shall be used if the unit meets all six of the conditions specified in paragraphs (b)(4)(ii)(A) through (b)(4)(ii)(F) of this section:
    - (A) The unit has a maximum rated heat input capacity greater than 250 mmBtu/hr, or if the unit combusts municipal solid waste and has a maximum rated input capacity greater than 600 tons per day of MSW.
    - (B) The unit combusts solid fossil fuel or MSW as the primary fuel.
    - (C) The unit has operated for more than 1,000 hours in any calendar year since 2005.
    - (D) The unit has installed CEMS that are required either by an applicable Federal or State regulation or the unit's operating permit.
    - (E) The installed CEMS include a gas monitor of any kind or a stack gas volumetric flow rate monitor, or both and the monitors have been certified, either in accordance with the requirements of part 75 of this chapter, part 60 of this chapter, or an applicable State continuous monitoring program.
    - (F) The installed gas or stack gas volumetric flow rate monitors are required, either by an applicable Federal or State regulation or by the unit's operating permit, to undergo periodic quality assurance testing in accordance with either appendix B to part 75 of this chapter, appendix F to part 60 of this chapter, or an applicable State continuous monitoring program.
  - (iii) Shall be used for a unit with a maximum rated heat input capacity of 250 mmBtu/hr or less and for a unit that combusts municipal solid waste with a maximum rated input capacity of 600 tons of MSW per day or less, if the unit meets all of the following three conditions:
    - (A) The unit has both a stack gas volumetric flow rate monitor and a CO<sub>2</sub> concentration monitor.
    - (B) The unit meets the conditions specified in paragraphs (b)(4)(ii)(B) through (b)(4)(ii)(D) of this section.

- (C) The CO<sub>2</sub> and stack gas volumetric flow rate monitors meet the conditions specified in paragraphs (b)(4)(ii)(E) and (b)(4)(ii)(F) of this section.
- (iv) May apply to common stack or duct configurations where:
  - (A) The combined effluent gas streams from two or more stationary fuel combustion units are vented through a monitored common stack or duct. In this case, Tier 4 shall be used if all of the conditions in paragraph (b)(4)(iv)(A)(1) of this section or if the conditions in paragraph (b)(4)(iv)(A)(2) of this section are met.
    - (1) At least one of the units meets the requirements of paragraphs (b)(4)(ii)(A) through (b)(4)(ii)(C) of this section, and the CEMS installed at the common stack (or duct) meet the requirements of paragraphs (b)(4)(ii)(D) through (b)(4)(ii)(F) of this section.
    - (2) At least one of the units and the monitors installed at the common stack or duct meet the requirements of paragraph (b)(4)(iii) of this section.
  - (B) The combined effluent gas streams from a process or manufacturing unit and a stationary fuel combustion unit are vented through a monitored common stack or duct. In this case, Tier 4 shall be used if the combustion unit and the monitors installed at the common stack or duct meet the applicability criteria specified in paragraph (b)(4)(iv)(A)(1), or (b)(4)(iv)(A)(2) of this section.
  - (C) The combined effluent gas streams from two or more manufacturing or process units are vented through a common stack or duct. In this case, if any of the units is required by an applicable subpart of this part to use Tier 4, the CO<sub>2</sub> mass emissions may be monitored at each individual unit, or the combined CO<sub>2</sub> mass emissions may be monitored at the common stack or duct. However, if it is not feasible to monitor the individual units, the combined CO<sub>2</sub> mass emissions shall be monitored at the common stack or duct.
- (5) The Tier 4 Calculation Methodology shall be used:
  - (i) Starting on January 1, 2010, for a unit that is required to report CO<sub>2</sub> mass emissions beginning on that date, if all of the monitors needed to measure CO<sub>2</sub> mass emissions have been installed and certified by that date.
  - (ii) No later than January 1, 2011, for a unit that is required to report CO<sub>2</sub> mass emissions beginning on January 1, 2010, if all of the monitors needed to measure CO<sub>2</sub> mass emissions have not been installed and certified by January 1, 2010. In this case, you may use Tier 2 or Tier 3 to report GHG emissions for 2010. However, if the required CEMS are certified some time in 2010, you need not wait until January 1, 2011 to begin using Tier 4. Rather, you may switch from Tier 2 or Tier 3 to Tier 4 as soon as CEMS certification testing is successfully completed. If this reporting option is chosen, you must document the change in CO<sub>2</sub> calculation methodology in the Monitoring Plan required under § 98.3(g)(5) and in the GHG emissions report under § 98.3(c). Data recorded by the CEMS during a certification test period in 2010 may be used for reporting under this part, provided that the following two conditions are met:
    - (A) The certification tests are passed in sequence, with no test failures.
    - (B) No unscheduled maintenance or repair of the CEMS is performed during the certification test period.

(iii) No later than 180 days following the date on which a change is made that triggers Tier 4 applicability under paragraph (b)(4)(ii) or (b)(4)(iii) of this section (e.g., a change in the primary fuel, manner of unit operation, or installed continuous monitoring equipment).

(6) You may elect to use any applicable higher tier for one or more of the fuels combusted in a unit. For example, if a 100 mmBtu/hr unit combusts natural gas and distillate fuel oil, you may elect to use Tier 1 for natural gas and Tier 3 for the fuel oil, even though Tier 1 could have been used for both fuels. However, for units that use either the Tier 4 or the alternative calculation methodology specified in paragraph (a)(5)(iii) of this section, CO<sub>2</sub> emissions from the combustion of all fuels shall be based solely on CEMS measurements.

(c) **Calculation of CH<sub>4</sub> and N<sub>2</sub>O emissions from stationary combustion sources.** You must calculate annual CH<sub>4</sub> and N<sub>2</sub>O mass emissions only for units that are required to report CO<sub>2</sub> emissions using the calculation methodologies of this subpart and for only those fuels that are listed in Table C-2 of this subpart.

(1) Use Equation C-8 of this section to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions for any fuels for which you use the Tier 1 or Tier 3 calculation methodologies for CO<sub>2</sub>, except when natural gas usage in units of therms or mmBtu is obtained from gas billing records. In that case, use Equation C-8a in paragraph (c)(1)(i) of this section or Equation C-8b in paragraph (c)(1)(ii) of this section (as applicable). For Equation C-8, use the same values for fuel consumption that you use for the Tier 1 or Tier 3 calculation.

$$CH_4 \text{ or } N_2O = 1 \times 10^{-3} * Fuel * HHV * EF \quad (\text{Eq. C-8})$$

Where:

CH<sub>4</sub> or N<sub>2</sub>O = Annual CH<sub>4</sub> or N<sub>2</sub>O emissions from the combustion of a particular type of fuel (metric tons).

Fuel = Mass or volume of the fuel combusted, either from company records or directly measured by a fuel flow meter, as applicable (mass or volume per year).

HHV = Default high heat value of the fuel from Table C-1 of this subpart; alternatively, for Tier 3, if actual HHV data are available for the reporting year, you may average these data using the procedures specified in paragraph (a)(2)(ii) of this section, and use the average value in Equation C-8 (mmBtu per mass or volume).

EF = Fuel-specific default emission factor for CH<sub>4</sub> or N<sub>2</sub>O, from table C-2 to this subpart (kg CH<sub>4</sub> or N<sub>2</sub>O per mmBtu), except for natural gas-fired reciprocating internal combustion engines and gas turbines at facilities subject to subpart W of this part, which must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

(i) Use Equation C-8a to calculate CH<sub>4</sub> and N<sub>2</sub>O emissions when natural gas usage is obtained from gas billing records in units of therms.

$$CH_4 \text{ or } N_2O = 1 \times 10^{-3} * Fuel * 0.1 * EF \quad (\text{Eq. C-8a})$$

where:



$\text{CH}_4$  or  $\text{N}_2\text{O}$  = Annual  $\text{CH}_4$  or  $\text{N}_2\text{O}$  emissions from the combustion of natural gas (metric tons).

Fuel = Annual natural gas usage, from gas billing records (therms).

EF = Fuel-specific default emission factor for  $\text{CH}_4$  or  $\text{N}_2\text{O}$ , from table C-2 to this subpart (kg  $\text{CH}_4$  or  $\text{N}_2\text{O}$  per mmBtu), except for natural gas-fired reciprocating internal combustion engines and gas turbines at facilities subject to subpart W of this part, which must use a  $\text{CH}_4$  emission factor determined in accordance with § 98.233(z)(4).

0.1 = Conversion factor from therms to mmBtu

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (ii) Use Equation C-8b to calculate  $\text{CH}_4$  and  $\text{N}_2\text{O}$  emissions when natural gas usage is obtained from gas billing records in units of mmBtu.

$$\text{CH}_4 \text{ or } \text{N}_2\text{O} = 1 \times 10^{-3} * \text{Fuel} * \text{EF} \text{ (Eq. C-8b)}$$

where:

$\text{CH}_4$  or  $\text{N}_2\text{O}$  = Annual  $\text{CH}_4$  or  $\text{N}_2\text{O}$  emissions from the combustion of natural gas (metric tons).

Fuel = Annual natural gas usage, from gas billing records (mmBtu).

EF = Fuel-specific default emission factor for  $\text{CH}_4$  or  $\text{N}_2\text{O}$ , from table C-2 to this subpart (kg  $\text{CH}_4$  or  $\text{N}_2\text{O}$  per mmBtu), except for natural gas-fired reciprocating internal combustion engines and gas turbines at facilities subject to subpart W of this part, which must use a  $\text{CH}_4$  emission factor determined in accordance with § 98.233(z)(4).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (2) Use Equation C-9a of this section to estimate  $\text{CH}_4$  and  $\text{N}_2\text{O}$  emissions for any fuels for which you use the Tier 2 Equation C-2a of this section to estimate  $\text{CO}_2$  emissions. Use the same values for fuel consumption and HHV that you use for the Tier 2 calculation.

$$\text{CH}_4 \text{ or } \text{N}_2\text{O} = 1 \times 10^{-3} * \text{HHV} * \text{EF} * \text{Fuel} \quad \text{(Eq. C-9a)}$$

Where:

$\text{CH}_4$  or  $\text{N}_2\text{O}$  = Annual  $\text{CH}_4$  or  $\text{N}_2\text{O}$  emissions from the combustion of a particular type of fuel (metric tons).

Fuel = Mass or volume of the fuel combusted during the reporting year.

HHV = High heat value of the fuel, averaged for all valid measurements for the reporting year (mmBtu per mass or volume).

EF = Fuel-specific default emission factor for CH<sub>4</sub> or N<sub>2</sub>O, from table C-2 to this subpart (kg CH<sub>4</sub> or N<sub>2</sub>O per mmBtu), except for natural gas-fired reciprocating internal combustion engines and gas turbines at facilities subject to subpart W of this part, which must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (3) Use Equation C-9b of this section to estimate CH<sub>4</sub> and N<sub>2</sub>O emissions for any fuels for which you use Equation C-2c of this section to calculate the CO<sub>2</sub> emissions. Use the same values for steam generation and the ratio "B" that you use for Equation C-2c.

$$\text{CH}_4 \text{ or N}_2\text{O} = 1 \times 10^{-3} \text{ Steam} \cdot B \cdot EF \quad (\text{Eq. C-9b})$$

Where:

CH<sub>4</sub> or N<sub>2</sub>O = Annual CH<sub>4</sub> or N<sub>2</sub>O emissions from the combustion of a solid fuel (metric tons).

Steam = Total mass of steam generated by solid fuel combustion during the reporting year (lb steam).

B = Ratio of the boiler's maximum rated heat input capacity to its design rated steam output (mmBtu/lb steam).

EF = Fuel-specific emission factor for CH<sub>4</sub> or N<sub>2</sub>O, from Table C-2 of this subpart (kg CH<sub>4</sub> or N<sub>2</sub>O per mmBtu).

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (4) Use Equation C-10 of this section for: units subject to subpart D of this part; units that qualify for and elect to use the alternative CO<sub>2</sub> mass emissions calculation methodologies described in paragraph (a)(5) of this section; and units that use the Tier 4 Calculation Methodology.

$$\text{CH}_4 \text{ or N}_2\text{O} = 0.001 \cdot (HI)_A \cdot EF \quad (\text{Eq. C-10})$$

Where:

CH<sub>4</sub> or N<sub>2</sub>O = Annual CH<sub>4</sub> or N<sub>2</sub>O emissions from the combustion of a particular type of fuel (metric tons).

(HI)<sub>A</sub> = Cumulative annual heat input from combustion of the fuel (mmBtu).

EF = Fuel-specific default emission factor for CH<sub>4</sub> or N<sub>2</sub>O, from table C-2 to this subpart (kg CH<sub>4</sub> or N<sub>2</sub>O per mmBtu), except for natural gas-fired reciprocating internal combustion engines and gas turbines at facilities subject to subpart W of this part, which must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4).

0.001 = Conversion factor from kg to metric tons.

- (i) If only one type of fuel listed in Table C-2 of this subpart is combusted during the reporting year, substitute the cumulative annual heat input from combustion of the fuel into Equation C-10 of this section to calculate the annual CH<sub>4</sub> or N<sub>2</sub>O emissions. For units in the Acid Rain Program

and units that report heat input data to EPA year-round according to part 75 of this chapter, obtain the cumulative annual heat input directly from the electronic data reports required under § 75.64 of this chapter. For Tier 4 units, use the best available information, as described in paragraph (c)(4)(ii)(C) of this section, to estimate the cumulative annual heat input (HI)<sub>A</sub>.

- (ii) If more than one type of fuel listed in Table C-2 of this subpart is combusted during the reporting year, use Equation C-10 of this section separately for each type of fuel, except as provided in paragraph (c)(4)(ii)(B) of this section. Determine the appropriate values of (HI)<sub>A</sub> as follows:
  - (A) For units in the Acid Rain Program and other units that report heat input data to EPA year-round according to part 75 of this chapter, obtain (HI)<sub>A</sub> for each type of fuel from the electronic data reports required under § 75.64 of this chapter, except as otherwise provided in paragraphs (c)(4)(ii)(B) and (c)(4)(ii)(D) of this section.
  - (B) For a unit that uses CEMS to monitor hourly heat input according to part 75 of this chapter, the value of (HI)<sub>A</sub> obtained from the electronic data reports under § 75.64 of this chapter may be attributed exclusively to the fuel with the highest F-factor, when the reporting option in 3.3.6.5 of appendix F to part 75 of this chapter is selected and implemented.
  - (C) For Tier 4 units, use the best available information (e.g., fuel feed rate measurements, fuel heating values, engineering analysis) to estimate the value of (HI)<sub>A</sub> for each type of fuel. Instrumentation used to make these estimates is not subject to the calibration requirements of § 98.3(i) or to the QA requirements of § 98.34.
  - (D) Units in the Acid Rain Program and other units that report heat input data to EPA year-round according to part 75 of this chapter may use the best available information described in paragraph (c)(4)(ii)(C) of this section, to estimate (HI)<sub>A</sub> for each fuel type, whenever fuel-specific heat input values cannot be directly obtained from the electronic data reports under § 75.64 of this chapter.
- (5) When multiple fuels are combusted during the reporting year, sum the fuel-specific results from Equations C-8, C-8a, C-8b, C-9a, C-9b, or C-10 of this section (as applicable) to obtain the total annual CH<sub>4</sub> and N<sub>2</sub>O emissions, in metric tons.
- (6) Calculate the annual CH<sub>4</sub> and N<sub>2</sub>O mass emissions from the combustion of blended fuels as follows:
  - (i) If the mass, volume, or heat input of each component fuel in the blend is determined before the fuels are mixed and combusted, calculate and report CH<sub>4</sub> and N<sub>2</sub>O emissions separately for each component fuel, using the applicable procedures in this paragraph (c).
  - (ii) If the mass, volume, or heat input of each component fuel in the blend is not determined before the fuels are mixed and combusted, a reasonable estimate of the percentage composition of the blend, based on best available information, is required. Perform the following calculations for each component fuel “i” that is listed in table C-2 to this subpart:
    - (A) Multiply (% Fuel)<sub>i</sub>, the estimated mass, volume, or heat input percentage of component fuel “i” (expressed as a decimal fraction), by the total annual mass, volume, or heat input of the blended fuel combusted during the reporting year, to obtain an estimate of the annual value for component “i”;
    - (B) [Reserved]

- (C) Calculate the annual CH<sub>4</sub> and N<sub>2</sub>O emissions from component “i”, using equation C-8 (fuel mass or volume) to this section, C-8a (fuel heat input) to this section, C-8b (fuel heat input) to this section, C-9a (fuel mass or volume) to this section, or C-10 (fuel heat input) to this section, as applicable;
- (D) Sum the annual CH<sub>4</sub> emissions across all component fuels to obtain the annual CH<sub>4</sub> emissions for the blend. Similarly sum the annual N<sub>2</sub>O emissions across all component fuels to obtain the annual N<sub>2</sub>O emissions for the blend. Report these annual emissions totals.

(d) **Calculation of CO<sub>2</sub> from sorbent.**

- (1) When a unit is a fluidized bed boiler, is equipped with a wet flue gas desulfurization system, or uses other acid gas emission controls with sorbent injection to remove acid gases, if the chemical reaction between the acid gas and the sorbent produces CO<sub>2</sub> emissions, use Equation C-11 of this section to calculate the CO<sub>2</sub> emissions from the sorbent, except when those CO<sub>2</sub> emissions are monitored by CEMS. When a sorbent other than CaCO<sub>3</sub> is used, determine site-specific values of R and MW<sub>S</sub>.

$$CO_2 = 0.91 \cdot S \cdot R \cdot \left( \frac{MW_{CO_2}}{MW_S} \right) \quad (\text{Eq. C-11})$$

Where:

CO<sub>2</sub> = CO<sub>2</sub> emitted from sorbent for the reporting year (metric tons).

S = Limestone or other sorbent used in the reporting year, from company records (short tons).

R = The number of moles of CO<sub>2</sub> released per mole of sorbent used (R = 1.00 when the sorbent is CaCO<sub>3</sub> and the targeted acid gas species is SO<sub>2</sub>).

MW<sub>CO2</sub> = Molecular weight of carbon dioxide (44).

MW<sub>S</sub> = Molecular weight of sorbent (100 if calcium carbonate).

0.91 = Conversion factor from short tons to metric tons.

- (2) The total annual CO<sub>2</sub> mass emissions reported for the unit shall include the CO<sub>2</sub> emissions from the combustion process and the CO<sub>2</sub> emissions from the sorbent.

- (e) **Biogenic CO<sub>2</sub> emissions from combustion of biomass with other fuels.** Use the applicable procedures of this paragraph (e) to estimate biogenic CO<sub>2</sub> emissions from units that combust a combination of biomass and fossil fuels (i.e., either co-fired or blended fuels). Separate reporting of biogenic CO<sub>2</sub> emissions from the combined combustion of biomass and fossil fuels is required for those biomass fuels listed in table C-1 to this subpart, MSW, and tires. In addition, when a biomass fuel that is not listed in table C-1 to this subpart is combusted in a unit that has a maximum rated heat input greater than 250 mmBtu/hr, if the biomass fuel accounts for 10% or more of the annual heat input to the unit, and if the unit does not use CEMS to quantify its annual CO<sub>2</sub> mass emissions, then, pursuant to paragraph (b)(3)(iii) of this section, Tier 3 must be used to determine the carbon content of the biomass fuel and to calculate the biogenic

CO<sub>2</sub> emissions from combustion of the fuel. Notwithstanding these requirements, in accordance with § 98.3(c)(12), separate reporting of biogenic CO<sub>2</sub> emissions is optional for the 2010 reporting year for units subject to subpart D of this part and for units that use the CO<sub>2</sub> mass emissions calculation methodologies in part 75 of this chapter, pursuant to paragraph (a)(5) of this section. However, if the owner or operator opts to report biogenic CO<sub>2</sub> emissions separately for these units, the appropriate method(s) in this paragraph (e) shall be used.

- (1) You may use equation C-1 to this section to calculate the annual CO<sub>2</sub> mass emissions from the combustion of the biomass fuels listed in table C-1 to this subpart, in a unit of any size, including units equipped with a CO<sub>2</sub> CEMS, except when the use of Tier 2 is required as specified in paragraph (b)(1)(iv) of this section. Determine the quantity of biomass combusted using one of the following procedures in this paragraph (e)(1), as appropriate, and document the selected procedures in the Monitoring Plan under § 98.3(g):
  - (i) Company records.
  - (ii) The procedures in paragraph (e)(4) of this section.
  - (iii) The best available information for premixed fuels that contain biomass and fossil fuels (e.g., liquid fuel mixtures containing biodiesel).
- (2) You may use the procedures of this paragraph if the following three conditions are met: First, a CO<sub>2</sub> CEMS (or a surrogate O<sub>2</sub> monitor) and a stack gas flow rate monitor are used to determine the annual CO<sub>2</sub> mass emissions (either according to part 75 of this chapter, the Tier 4 Calculation Methodology, or the alternative calculation methodology specified in paragraph (a)(5)(iii) of this section); second, neither MSW nor tires is combusted in the unit during the reporting year; and third, the CO<sub>2</sub> emissions consist solely of combustion products (i.e., no process or sorbent emissions included).
  - (i) For each operating hour, use Equation C-12 of this section to determine the volume of CO<sub>2</sub> emitted.

$$V_{CO_2h} = \frac{(\%CO_2)_h}{100} \times Q_h \times t_h \quad (\text{Eq. C-12})$$

Where:

$V_{CO_2h}$  = Hourly volume of CO<sub>2</sub> emitted (scf).

$(\%CO_2)_h$  = Hourly average CO<sub>2</sub> concentration, measured by the CO<sub>2</sub> concentration monitor, or, if applicable, calculated from the hourly average O<sub>2</sub> concentration ( $\%CO_2$ ).

$Q_h$  = Hourly average stack gas volumetric flow rate, measured by the stack gas volumetric flow rate monitor (scfh).

$t_h$  = Source operating time (decimal fraction of the hour during which the source combusts fuel, i.e., 1.0 for a full operating hour, 0.5 for 30 minutes of operation, etc.).

100 = Conversion factor from percent to a decimal fraction.

- (ii) Sum all of the hourly  $V_{CO_2h}$  values for the reporting year, to obtain  $V_{total}$ , the total annual volume of  $CO_2$  emitted.
- (iii) Calculate the annual volume of  $CO_2$  emitted from fossil fuel combustion using Equation C-13 of this section. If two or more types of fossil fuel are combusted during the year, perform a separate calculation with Equation C-13 of this section for each fuel and sum the results.

$$V_{ff} = \frac{Fuel \cdot F_c \cdot HHV}{10^6} \quad (\text{Eq. C-13})$$

Where:

$V_{ff}$  = Annual volume of  $CO_2$  emitted from combustion of a particular fossil fuel (scf).

Fuel = Total quantity of the fossil fuel combusted in the reporting year, from company records, as defined in § 98.6 (lb for solid fuel, gallons for liquid fuel, and scf for gaseous fuel).

$F_c$  = Fuel-specific carbon based F-factor, either a default value from Table 1 in section 3.3.5 of appendix F to part 75 of this chapter, or a site-specific value determined under section 3.3.6 of appendix F to part 75 (scf  $CO_2$ /mmBtu).

HHV = High heat value of the fossil fuel, from fuel sampling and analysis (annual average value in Btu/lb for solid fuel, Btu/gal for liquid fuel and Btu/scf for gaseous fuel, sampled as specified (e.g., monthly, quarterly, semi-annually, or by lot) in § 98.34(a)(2)). The average HHV shall be calculated according to the requirements of paragraph (a)(2)(ii) of this section.

$10^6$  = Conversion factor, Btu per mmBtu.

- (iv) Subtract  $V_{ff}$  from  $V_{total}$  to obtain  $V_{bio}$ , the annual volume of  $CO_2$  from the combustion of biomass.
- (v) Calculate the biogenic percentage of the annual  $CO_2$  emissions, expressed as a decimal fraction, using Equation C-14 of this section:

$$\% \text{ Biogenic} = \frac{V_{bio}}{V_{total}} \quad (\text{Eq. C-14})$$

- (vi) Calculate the annual biogenic  $CO_2$  mass emissions, in metric tons, by multiplying the results obtained from Equation C-14 of this section by the annual  $CO_2$  mass emissions in metric tons, as determined:
  - (A) Under paragraph (a)(4)(vi) of this section, for units using the Tier 4 Calculation Methodology.
  - (B) Under paragraph (a)(5)(iii)(B) of this section, for units using the alternative calculation methodology specified in paragraph (a)(5)(iii).

- (C) From the electronic data report required under § 75.64 of this chapter, for units in the Acid Rain Program and other units using CEMS to monitor and report CO<sub>2</sub> mass emissions according to part 75 of this chapter. However, before calculating the annual biogenic CO<sub>2</sub> mass emissions, multiply the cumulative annual CO<sub>2</sub> mass emissions by 0.91 to convert from short tons to metric tons.
- (3) You must use the procedures in paragraphs (e)(3)(i) through (iii) of this section to determine the annual biogenic CO<sub>2</sub> emissions from the combustion of MSW, except as otherwise provided in paragraph (e)(3)(iv) of this section. These procedures also may be used for any unit that co-fires biomass and fossil fuels, including units equipped with a CO<sub>2</sub> CEMS.
  - (i) Use an applicable CO<sub>2</sub> emissions calculation method in this section to quantify the total annual CO<sub>2</sub> mass emissions from the unit.
  - (ii) Determine the relative proportions of biogenic and non-biogenic CO<sub>2</sub> emissions in the flue gas on a quarterly basis using the method specified in § 98.34(d) (for units that combust MSW as the primary fuel or as the only fuel with a biogenic component) or in § 98.34(e) (for other units, including units that combust tires).
  - (iii) Determine the annual biogenic CO<sub>2</sub> mass emissions from the unit by multiplying the total annual CO<sub>2</sub> mass emissions by the annual average biogenic decimal fraction obtained from § 98.34(d) or § 98.34(e), as applicable.
  - (iv) In lieu of following the procedures in paragraphs (e)(3)(i) through (iii) of this section, the procedures of this paragraph (e)(3)(iv) may be used for the combustion of tires regardless of the percent of the annual heat input provided by tires. The calculation procedure in this paragraph (e)(3)(iv) may be used for the combustion of MSW if the combustion of MSW provides no more than 10 percent of the annual heat input to the unit or if a small, batch incinerator combusts no more than 1,000 tons per year of MSW.
    - (A) Calculate the total annual CO<sub>2</sub> emissions from combustion of MSW and/or tires in the unit, using the applicable methodology in paragraphs (a)(1) through (3) of this section for units using Tier 1, Tier 2, or Tier 3; otherwise use the Tier 1 calculation methodology in paragraph (a)(1) of this section for units using either the Tier 4 or Alternative Part 75 calculation methodologies to calculate total CO<sub>2</sub> emissions.
    - (B) Multiply the result from paragraph (e)(3)(iv)(A) of this section by the appropriate default factor to determine the annual biogenic CO<sub>2</sub> emissions, in metric tons. For MSW, use a default factor of 0.60 and for tires, use a default factor of 0.24.
- (4) If Equation C-1 or Equation C-2a of this section is selected to calculate the annual biogenic mass emissions for wood, wood waste, or other solid biomass-derived fuel, Equation C-15 of this section may be used to quantify biogenic fuel consumption, provided that all of the required input parameters are accurately quantified. Similar equations and calculation methodologies based on steam generation and boiler efficiency may be used, provided that they are documented in the GHG Monitoring Plan required by § 98.3(g)(5).

$$(Fuel)_F = \frac{[H + S] - (Hf)_{nb}}{2000 (HHV)_{bio} (Eff)_{bio}} \quad (Eq. C-15)$$

Where:



$(\text{Fuel})_p$  = Quantity of biomass consumed during the measurement period “p” (tons/year or tons/month, as applicable).

H = Average enthalpy of the boiler steam for the measurement period (Btu/lb).

S = Total boiler steam production for the measurement period (lb/month or lb/year, as applicable).

$(\text{HI})_{nb}$  = Heat input from co-fired fossil fuels and non-biomass-derived fuels for the measurement period, based on company records of fuel usage and default or measured HHV values (Btu/month or Btu/year, as applicable).

$(\text{HHV})_{bio}$  = Default or measured high heat value of the biomass fuel (Btu/lb).

$(\text{Eff})_{bio}$  = Percent efficiency of biomass-to-energy conversion, expressed as a decimal fraction.

2000 = Conversion factor (lb/ton).

- (5) For units subject to subpart D of this part and for units that use the methods in part 75 of this chapter to quantify CO<sub>2</sub> mass emissions in accordance with paragraph (a)(5) of this section, you may calculate biogenic CO<sub>2</sub> emissions from the combustion of biomass fuels listed in Table C-1 of this subpart using Equation C-15a. This equation may not be used to calculate biogenic CO<sub>2</sub> emissions from the combustion of tires or MSW; the methods described in paragraph (e)(3) of this section must be used for those fuels. Whenever  $(\text{HI})_A$ , the annual heat input from combustion of biomass fuel in Equation C-15a, cannot be determined solely from the information in the electronic emissions reports under § 75.64 of this chapter (e.g., in cases where a unit uses CEMS in combination with multiple F-factors, a worst-case F-factor, or a prorated F-factor to report heat input rather than reporting heat input based on fuel type), use the best available information (as described in §§ 98.33(c)(4)(ii)(C) and (c)(4)(ii)(D)) to determine  $(\text{HI})_A$ .

$$\text{CO}_2 = 0.001 * (\text{HI})_A * EF \text{ (Eq. C-15a)}$$

where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from the combustion of a particular type of biomass fuel listed in Table C-1 (metric tons)

$(\text{HI})_A$  = Annual heat input from the biomass fuel, obtained, where feasible, from the electronic emissions reports required under § 75.64 of this chapter. Where this is not feasible use best available information, as described in §§ 98.33(c)(4)(ii)(C) and (c)(4)(ii)(D) (mmBtu)

EF = CO<sub>2</sub> emission factor for the biomass fuel, from Table C-1 (kg CO<sub>2</sub>/mmBtu)

0.001 = Conversion factor from kg to metric tons

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## § 98.34 Monitoring and QA/QC requirements.

The CO<sub>2</sub> mass emissions data for stationary fuel combustion sources shall be monitored as follows:

(a) For the Tier 2 Calculation Methodology:

- (1) All fuel samples shall be taken at a location in the fuel handling system that provides a sample representative of the fuel combusted. The fuel sampling and analysis may be performed by either the owner or operator or the supplier of the fuel.
- (2) The minimum required frequency of the HHV sampling and analysis for each type of fuel or fuel mixture (blend) is specified in this paragraph. When the specified frequency for a particular fuel or blend is based on a specified time period (e.g., week, month, quarter, or half-year), fuel sampling and analysis is required only for those time periods in which the fuel or blend is combusted. The owner or operator may perform fuel sampling and analysis more often than the minimum required frequency, in order to obtain a more representative annual average HHV.
  - (i) For natural gas, semiannual sampling and analysis is required (i.e., twice in a calendar year, with consecutive samples taken at least four months apart).
  - (ii) For coal and fuel oil, and for any other solid or liquid fuel that is delivered in lots, analysis of at least one representative sample from each fuel lot is required. For fuel oil, as an alternative to sampling each fuel lot, a sample may be taken upon each addition of oil to the unit's storage tank. Flow proportional sampling, continuous drip sampling, or daily manual oil sampling may also be used, in lieu of sampling each fuel lot. If the daily manual oil sampling option is selected, sampling from a particular tank is required only on days when oil from the tank is combusted by the unit (or units) served by the tank. If you elect to sample from the storage tank upon each addition of oil to the tank, you must take at least one sample from each tank that is currently in service and whenever oil is added to the tank, for as long as the tank remains in service. You need not take any samples from a storage tank while it is out of service. Rather, take a sample when the tank is brought into service and whenever oil is added to the tank, for as long as the tank remains in service. If multiple additions of oil are made to a particular in-service tank on a given day (e.g., from multiple deliveries), one sample taken after the final addition of oil is sufficient. For the purposes of this section, a fuel lot is defined as a shipment or delivery of a single type of fuel (e.g., ship load, barge load, group of trucks, group of railroad cars, oil delivery via pipeline from a tank farm, etc.). However, if multiple deliveries of a particular type of fuel are received from the same supply source in a given calendar month, the deliveries for that month may be considered, collectively, to comprise a fuel lot, requiring only one representative sample, subject to the following conditions:
    - (A) For coal, the "type" of fuel means the rank of the coal (i.e., anthracite, bituminous, sub-bituminous, or lignite). For fuel oil, the "type" of fuel means the grade number or classification of the oil (e.g., No. 1 oil, No. 2 oil, kerosene, Jet A fuel, etc.).
    - (B) The owner or operator shall document in the monitoring plan under § 98.3(g)(5) how the monthly sampling of each type of fuel is performed.
  - (iii) For liquid fuels other than fuel oil, and for gaseous fuels other than natural gas (including biogas), sampling and analysis is required at least once per calendar quarter. To the extent practicable, consecutive quarterly samples shall be taken at least 30 days apart.

- (iv) For other solid fuels (except MSW), weekly sampling is required to obtain composite samples, which are then analyzed monthly.
  - (v) For fuel blends that are received already mixed, or that are mixed on-site without measuring the exact amount of each component, as described in paragraph (a)(3)(ii) of this section, determine the HHV of the blend as follows. For blends of solid fuels (except MSW), weekly sampling is required to obtain composite samples, which are analyzed monthly. For blends of liquid or gaseous fuels, sampling and analysis is required at least once per calendar quarter. More frequent sampling is recommended if the composition of the blend varies significantly during the year.
- (3) **Special considerations for blending of fuels.** In situations where different types of fuel listed in Table C-1 of this subpart (for example, different ranks of coal or different grades of fuel oil) are in the same state of matter (*i.e.*, solid, liquid, or gas), and are blended prior to combustion, use the following procedures to determine the appropriate CO<sub>2</sub> emission factor and HHV for the blend.
- (i) If the fuels to be blended are received separately, and if the quantity (mass or volume) of each fuel is measured before the fuels are mixed and combusted, then, for each component of the blend, calculate the CO<sub>2</sub> mass emissions separately. Substitute into Equation C-2a of this subpart the total measured mass or volume of the component fuel (from company records), together with the appropriate default CO<sub>2</sub> emission factor from Table C-1, and the annual average HHV, calculated according to § 98.33(a)(2)(ii). In this case, the fact that the fuels are blended prior to combustion is of no consequence.
  - (ii) If the fuel is received as a blend (*i.e.*, already mixed) or if the components are mixed on site without precisely measuring the mass or volume of each one individually, a reasonable estimate of the relative proportions of the components of the blend must be made, using the best available information (*e.g.*, the approximate annual average mass or volume percentage of each fuel, based on the typical or expected range of values). Determine the appropriate CO<sub>2</sub> emission factor and HHV for use in Equation C-2a of this subpart, as follows:
    - (A) Consider the blend to be the “fuel type,” measure its HHV at the frequency prescribed in paragraph (a)(2)(v) of this section, and determine the annual average HHV value for the blend according to § 98.33(a)(2)(ii).
    - (B) Calculate a heat-weighted CO<sub>2</sub> emission factor, (EF)<sub>B</sub>, for the blend, using Equation C-16 of this section. The heat-weighting in Equation C-16 is provided by the default HHVs (from Table C-1) and the estimated mass or volume percentages of the components of the blend.
    - (C) Substitute into Equation C-2a of this subpart, the annual average HHV for the blend (from paragraph (a)(3)(ii)(A) of this section) and the calculated value of (EF)<sub>B</sub>, along with the total mass or volume of the blend combusted during the reporting year, to determine the annual CO<sub>2</sub> mass emissions from combustion of the blend.

$$(EF)_B = \frac{\sum_{i=1}^n [(HHV)_i (\%Fuel)_i (EF)_i]}{(HHV)_B} \quad (\text{Eq. C-16})$$

where:

$(EF)_B$  = Heat-weighted CO<sub>2</sub> emission factor for the blend (kg CO<sub>2</sub>/mmBtu)

$(HHV)_i$  = Default high heat value for fuel “i” in the blend, from Table C-1 (mmBtu per mass or volume)

$(\%Fuel)_i$  = Estimated mass or volume percentage of fuel “i” (mass % or volume %, as applicable, expressed as a decimal fraction; e.g., 25% = 0.25)

$(EF)_i$  = Default CO<sub>2</sub> emission factor for fuel “i” from Table C-1 (mmBtu per mass or volume)

$(HHV)_B$  = Annual average high heat value for the blend, calculated according to § 98.33(a)(2)(ii) (mmBtu per mass or volume)

- (iii) Note that for the case described in paragraph (a)(3)(ii) of this section, if measured HHV values for the individual fuels in the blend or for the blend itself are not routinely received at the minimum frequency prescribed in paragraph (a)(2) of this section (or at a greater frequency), and if the unit qualifies to use Tier 1, calculate  $(HHV)_B^*$ , the heat-weighted default HHV for the blend, using Equation C-17 of this section. Then, use Equation C-16 of this section, replacing the term  $(HHV)_B$  with  $(HHV)_B^*$  in the denominator, to determine the heat-weighted CO<sub>2</sub> emission factor for the blend. Finally, substitute into Equation C-1 of this subpart, the calculated values of  $(HHV)_B^*$  and  $(EF)_B$ , along with the total mass or volume of the blend combusted during the reporting year, to determine the annual CO<sub>2</sub> mass emissions from combustion of the blend.

$$HHV_B^* = \sum_{i=1}^n [(HHV)_i (\%Fuel)_i]$$

(Eq. C-17)

where:

$(HHV)_B^*$  = Heat-weighted default high heat value for the blend (mmBtu per mass or Volume)

$(HHV)_i$  = Default high heat value for fuel “i” in the blend, from Table C-1 (mmBtu per mass or volume)

$(\%Fuel)_i$  = Estimated mass or volume percentage of fuel “i” in the blend (mass % or volume %, as applicable, expressed as a decimal fraction)

- (iv) If the fuel blend described in paragraph (a)(3)(ii) of this section consists of a mixture of fuel(s) listed in Table C-1 of this subpart and one or more fuels not listed in Table C-1, calculate CO<sub>2</sub> and other GHG emissions only for the Table C-1 fuel(s), using the best available estimate of the mass or volume percentage(s) of the Table C-1 fuel(s) in the blend. In this case, Tier 1 shall be used, with the following modifications to Equations C-17 and C-1, to account for the fact that not all of the fuels in the blend are listed in Table C-1:

- (A) In Equation C-17, apply the term  $(Fuel)_i$  only to the Table C-1 fuels. For each Table C-1 fuel,  $(Fuel)_i$  will be the estimated mass or volume percentage of the fuel in the blend, divided by the sum of the mass or volume percentages of the Table C-1 fuels. For example, suppose that a blend consists of two Table C-1 fuels (“A” and “B”) and one fuel type (“C”) not listed in the Table, and that the volume percentages of fuels A, B, and C in the blend, expressed

as decimal fractions, are, respectively, 0.50, 0.30, and 0.20. The term  $(\text{Fuel})_i$  in Equation C-17 for fuel A will be  $0.50/(0.50 + 0.30) = 0.625$ , and for fuel B,  $(\text{Fuel})_i$  will be  $0.30/(0.50 + 0.30) = 0.375$ .

(B) In Equation C-1, the term "Fuel" will be equal to the total mass or volume of the blended fuel combusted during the year multiplied by the sum of the mass or volume percentages of the Table C-1 fuels in the blend. For the example in paragraph (a)(3)(iv)(A) of this section, "Fuel" = (Annual volume of the blend combusted)(0.80).

- (4) If, for a particular type of fuel, HHV sampling and analysis is performed more often than the minimum frequency specified in paragraph (a)(2) of this section, the results of all valid fuel analyses shall be used in the GHG emission calculations.
- (5) If, for a particular type of fuel, valid HHV values are obtained at less than the minimum frequency specified in paragraph (a)(2) of this section, appropriate substitute data values shall be used in the emissions calculations, in accordance with missing data procedures of § 98.35.
- (6) You must use one of the following appropriate fuel sampling and analysis methods. The HHV may be calculated using chromatographic analysis together with standard heating values of the fuel constituents, provided that the gas chromatograph is operated, maintained, and calibrated according to the manufacturer's instructions. Alternatively, you may use a method published by a consensus-based standards organization if such a method exists, or you may use industry standard practice to determine the high heat values. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>). The method(s) used shall be documented in the Monitoring Plan required under § 98.3(g)(5).

(b) For the Tier 3 Calculation Methodology:

- (1) You must calibrate each oil and gas flow meter according to § 98.3(i) and the provisions of this paragraph (b)(1).
  - (i) Perform calibrations using any of the test methods and procedures in this paragraph (b)(1)(i). The method(s) used shall be documented in the Monitoring Plan required under § 98.3(g)(5).
    - (A) You may use the calibration procedures specified by the flow meter manufacturer.
    - (B) You may use an appropriate flow meter calibration method published by a consensus-based standards organization, if such a method exists. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical

Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>).

- (C) You may use an industry-accepted practice.
- (ii) In addition to the initial calibration required by § 98.3(i), recalibrate each fuel flow meter (except as otherwise provided in paragraph (b)(1)(iii) of this section) according to one of the following. You may recalibrate annually, at the minimum frequency specified by the manufacturer, or at the interval specified by industry standard practice.
- (iii) Fuel billing meters are exempted from the initial and ongoing calibration requirements of this paragraph and from the Monitoring Plan and recordkeeping requirements of §§ 98.3(g)(5)(i)(C), (g)(6), and (g)(7), provided that the fuel supplier and the unit combusting the fuel do not have any common owners and are not owned by subsidiaries or affiliates of the same company. Meters used exclusively to measure the flow rates of fuels that are only used for unit startup are also exempted from the initial and ongoing calibration requirements of this paragraph.
- (iv) For the initial calibration of an orifice, nozzle, or venturi meter; in-situ calibration of the transmitters is sufficient. A primary element inspection (PEI) shall be performed at least once every three years.
- (v) For the continuously-operating units and processes described in § 98.3(i)(6), the required flow meter recalibrations and, if necessary, the PEIs may be postponed until the next scheduled maintenance outage.
- (vi) If a mixture of liquid or gaseous fuels is transported by a common pipe, you may either separately meter each of the fuels prior to mixing, using flow meters calibrated according to § 98.3(i), or consider the fuel mixture to be the “fuel type” and meter the mixed fuel, using a flow meter calibrated according to § 98.3(i).
- (2) Oil tank drop measurements (if used to determine liquid fuel use volume) shall be performed according to any appropriate method published by a consensus-based standards organization (e.g., the American Petroleum Institute).
- (3) The carbon content and, if applicable, molecular weight of the fuels shall be determined according to the procedures in this paragraph (b)(3).
  - (i) All fuel samples shall be taken at a location in the fuel handling system that provides a sample representative of the fuel combusted. The fuel sampling and analysis may be performed by either the owner or operator or by the supplier of the fuel.
  - (ii) For each type of fuel, the minimum required frequency for collecting and analyzing samples for carbon content and (if applicable) molecular weight is specified in this paragraph. When the sampling frequency is based on a specified time period (e.g., week, month, quarter, or half-year), fuel sampling and analysis is required for only those time periods in which the fuel is combusted.
    - (A) For natural gas, semiannual sampling and analysis is required (i.e., twice in a calendar year, with consecutive samples taken at least four months apart).

- (B) For coal and fuel oil and for any other solid or liquid fuel that is delivered in lots, analysis of at least one representative sample from each fuel lot is required. For fuel oil, as an alternative to sampling each fuel lot, a sample may be taken upon each addition of oil to the storage tank. Flow proportional sampling, continuous drip sampling, or daily manual oil sampling may also be used, in lieu of sampling each fuel lot. If the daily manual oil sampling option is selected, sampling from a particular tank is required only on days when oil from the tank is combusted by the unit (or units) served by the tank. If you elect to sample from the storage tank upon each addition of oil to the tank, you must take at least one sample from each tank that is currently in service and whenever oil is added to the tank, for as long as the tank remains in service. You need not take any samples from a storage tank while it is out of service. Rather, take a sample when the tank is brought into service and whenever oil is added to the tank, for as long as the tank remains in service. If multiple additions of oil are made to a particular in service tank on a given day (e.g., from multiple deliveries), one sample taken after the final addition of oil is sufficient. For the purposes of this section, a fuel lot is defined as a shipment or delivery of a single type of fuel (e.g., ship load, barge load, group of trucks, group of railroad cars, oil delivery via pipeline from a tank farm, etc.). However, if multiple deliveries of a particular type of fuel are received from the same supply source in a given calendar month, the deliveries for that month may be considered, collectively, to comprise a fuel lot, requiring only one representative sample, subject to the following conditions:
- (1) For coal, the “type” of fuel means the rank of the coal (i.e., anthracite, bituminous, sub-bituminous, or lignite). For fuel oil, the “type” of fuel means the grade number or classification of the oil (e.g., No. 1 oil, No. 2 oil, kerosene, Jet A fuel, etc.).
  - (2) The owner or operator shall document in the monitoring plan under § 98.3(g)(5) how the monthly sampling of each type of fuel is performed.
- (C) For liquid fuels other than fuel oil and for biogas, sampling and analysis is required at least once per calendar quarter. To the extent practicable, consecutive quarterly samples shall be taken at least 30 days apart.
- (D) For other solid fuels (except MSW), weekly sampling is required to obtain composite samples, which are then analyzed monthly.
- (E) For gaseous fuels other than natural gas and biogas (e.g., process gas), daily sampling and analysis to determine the carbon content and molecular weight of the fuel is required if continuous, on-line equipment, such as a gas chromatograph, is in place to make these measurements. Otherwise, weekly sampling and analysis shall be performed.
- (F) For mixtures (blends) of solid fuels, weekly sampling is required to obtain composite samples, which are analyzed monthly. For blends of liquid fuels, and for gas mixtures consisting only of natural gas and biogas, sampling and analysis is required at least once per calendar quarter. For gas mixtures that contain gases other than natural gas (including biogas), daily sampling and analysis to determine the carbon content and molecular weight of the fuel is required if continuous, on-line equipment is in place to make these measurements. Otherwise, weekly sampling and analysis shall be performed.
- (iii) If, for a particular type of fuel, sampling and analysis for carbon content and molecular weight is performed more often than the minimum frequency specified in paragraph (b)(3) of this section, the results of all valid fuel analyses shall be used in the GHG emission calculations.

- (iv) If, for a particular type of fuel, sampling and analysis for carbon content and molecular weight is performed at less than the minimum frequency specified in paragraph (b)(3) of this section, appropriate substitute data values shall be used in the emissions calculations, in accordance with the missing data procedures of § 98.35.
- (v) To calculate the CO<sub>2</sub> mass emissions from combustion of a blend of fuels in the same state of matter (solid, liquid, or gas), you may either:
  - (A) Apply Equation C-3, C-4 or C-5 of this subpart (as applicable) to each component of the blend, if the mass or volume, the carbon content, and (if applicable), the molecular weight of each component are accurately measured prior to blending; or
  - (B) Consider the blend to be the “fuel type.” Then, at the frequency specified in paragraph (b)(3)(ii)(F) of this section, measure the carbon content and, if applicable, the molecular weight of the blend and calculate the annual average value of each parameter in the manner described in § 98.33(a)(2)(ii). Also measure the mass or volume of the blended fuel combusted during the reporting year. Substitute these measured values into Equation C-3, C-4, or C-5 of this subpart (as applicable).
- (4) You must use one of the following appropriate fuel sampling and analysis methods. The results of chromatographic analysis of the fuel may be used, provided that the gas chromatograph is operated, maintained, and calibrated according to the manufacturer's instructions. Alternatively, you may use a method published by a consensus-based standards organization if such a method exists, or you may use industry standard practice to determine the carbon content and molecular weight (for gaseous fuel) of the fuel. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>). The method(s) used shall be documented in the Monitoring Plan required under § 98.3(g)(5).
- (c) For the Tier 4 Calculation Methodology, the CO<sub>2</sub>, flow rate, and (if applicable) moisture monitors must be certified prior to the applicable deadline specified in § 98.33(b)(5).
  - (1) For initial certification, you may use any one of the following three procedures in this paragraph.
    - (i) §§ 75.20(c)(2), (c)(4), and (c)(5) through (c)(7) of this chapter and appendix A to part 75 of this chapter.
    - (ii) The calibration drift test and relative accuracy test audit (RATA) procedures of Performance Specification 3 in appendix B to part 60 of this chapter (for the CO<sub>2</sub> concentration monitor) and Performance Specification 6 in appendix B to part 60 of this chapter (for the continuous emission rate monitoring system (CERMS)).
    - (iii) The provisions of an applicable State continuous monitoring program.

- (2) If an O<sub>2</sub> concentration monitor is used to determine CO<sub>2</sub> concentrations, the applicable provisions of part 75 of this chapter, part 60 of this chapter, or an applicable State continuous monitoring program shall be followed for initial certification and on-going quality assurance, and all required RATAs of the monitor shall be done on a percent CO<sub>2</sub> basis.
  - (3) For ongoing quality assurance, follow the applicable procedures in either appendix B to part 75 of this chapter, appendix F to part 60 of this chapter, or an applicable State continuous monitoring program. If appendix F to part 60 of this chapter is selected for on-going quality assurance, perform daily calibration drift assessments for both the CO<sub>2</sub> monitor (or surrogate O<sub>2</sub> monitor) and the flow rate monitor, conduct cylinder gas audits of the CO<sub>2</sub> concentration monitor in three of the four quarters of each year (except for non-operating quarters), and perform annual RATAs of the CO<sub>2</sub> concentration monitor and the CERMS.
  - (4) For the purposes of this part, the stack gas volumetric flow rate monitor RATAs required by appendix B to part 75 of this chapter and the annual RATAs of the CERMS required by appendix F to part 60 of this chapter need only be done at one operating level, representing normal load or normal process operating conditions, both for initial certification and for ongoing quality assurance.
  - (5) If, for any source operating hour, quality assured data are not obtained with a CO<sub>2</sub> monitor (or surrogate O<sub>2</sub> monitor), flow rate monitor, or (if applicable) moisture monitor, use appropriate substitute data values in accordance with the missing data provisions of § 98.35.
  - (6) For applications where CO<sub>2</sub> concentrations in process and/or combustion flue gasses are lower or higher than the typical CO<sub>2</sub> span value for coal-based fuels (e.g., 20 percent CO<sub>2</sub> for a coal fired boiler), cylinder gas audits of the CO<sub>2</sub> monitor under appendix F to part 60 of this chapter may be performed at 40-60 percent and 80-100 percent of CO<sub>2</sub> span, in lieu of the prescribed calibration levels of 5-8 percent and 10-14 percent CO<sub>2</sub> by volume.
  - (7) Hourly average data from the CEMS shall be validated in a manner consistent with one of the following: §§ 60.13(h)(2)(i) through (h)(2)(vi) of this chapter; § 75.10(d)(1) of this chapter; or the hourly data validation requirements of an applicable State CEM regulation.
- (d) Except as otherwise provided in § 98.33(e)(3)(iv), when municipal solid waste (MSW) is either the primary fuel combusted in a unit or the only fuel with a biogenic component combusted in the unit, determine the biogenic portion of the CO<sub>2</sub> emissions using ASTM D6866-16 and ASTM D7459-08 (both incorporated by reference, see § 98.7). Perform the ASTM D7459-08 sampling and the ASTM D6866-16 analysis at least once in every calendar quarter in which MSW is combusted in the unit. Collect each gas sample during normal unit operating conditions for at least 24 total (not necessarily consecutive) hours, or longer if the facility deems it necessary to obtain a representative sample. Notwithstanding this requirement, if the types of fuels combusted and their relative proportions are consistent throughout the year, the minimum required sampling time may be reduced to 8 hours if at least two 8-hour samples and one 24-hour sample are collected under normal operating conditions, and arithmetic average of the biogenic fraction of the flue gas from the 8-hour samples (expressed as a decimal) is within ±5 percent of the biogenic fraction from the 24-hour test. There must be no overlapping of the 8-hour and 24-hour test periods. Document the results of the demonstration in the unit's monitoring plan. If the types of fuels and their relative proportions are not consistent throughout the year, an optional sampling approach that facilities may wish to consider to obtain a more representative sample is to collect an integrated sample by extracting a small amount of flue gas (e.g., 1 to 5 cc) in each unit operating hour during the quarter. Separate the total annual CO<sub>2</sub> emissions into the biogenic and non-biogenic fractions using the average proportion of



biogenic emissions of all samples analyzed during the reporting year. Express the results as a decimal fraction (e.g., 0.30, if 30 percent of the CO<sub>2</sub> is biogenic). When MSW is the primary fuel for multiple units at the facility, and the units are fed from a common fuel source, testing at only one of the units is sufficient.

- (e) For other units that combust combinations of biomass fuel(s) (or heterogeneous fuels that have a biomass component, e.g., tires) and fossil (or other non-biogenic) fuel(s), in any proportions, ASTM D6866-16 and ASTM D7459-08 (both incorporated by reference, see § 98.7) may be used to determine the biogenic portion of the CO<sub>2</sub> emissions in every calendar quarter in which biomass and non-biogenic fuels are co-fired in the unit. Follow the procedures in paragraph (d) of this section. If multiple units at the facility are fed from a common fuel source, testing at only one of the units is sufficient.
- (f) The records required under § 98.3(g)(2)(i) shall include an explanation of how the following parameters are determined from company records (or, if applicable, from the best available information):
  - (1) Fuel consumption, when the Tier 1 and Tier 2 Calculation Methodologies are used, including cases where § 98.36(c)(4) applies.
  - (2) Fuel consumption, when solid fuel is combusted and the Tier 3 Calculation Methodology is used.
  - (3) Fossil fuel consumption when § 98.33(e)(2) applies to a unit that uses CEMS to quantify CO<sub>2</sub> emissions and that combusts both fossil and biomass fuels.
  - (4) Sorbent usage, when § 98.33(d) applies.
  - (5) Quantity of steam generated by a unit when § 98.33(a)(2)(iii) applies.
  - (6) Biogenic fuel consumption and high heating value, as applicable, under §§ 98.33(e)(5) and (e)(6).
  - (7) Fuel usage for CH<sub>4</sub> and N<sub>2</sub>O emissions calculations under § 98.33(c)(4)(ii).
  - (8) Mass of biomass combusted, for premixed fuels that contain biomass and fossil fuels under § 98.33(e)(1)(iii).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79146, Dec. 17, 2010; 81 FR 89251, Dec. 9, 2016; 89 FR 31902, Apr. 25, 2024]

### § 98.35 Procedures for estimating missing data.

Whenever a quality-assured value of a required parameter is unavailable (e.g., if a CEMS malfunctions during unit operation or if a required fuel sample is not taken), a substitute data value for the missing parameter shall be used in the calculations.

- (a) For all units subject to the requirements of the Acid Rain Program, and all other stationary combustion units subject to the requirements of this part that monitor and report emissions and heat input data year-round in accordance with part 75 of this chapter, the missing data substitution procedures in part 75 of this chapter shall be followed for CO<sub>2</sub> concentration, stack gas flow rate, fuel flow rate, high heating value, and fuel carbon content.
- (b) For units that use the Tier 1, Tier 2, Tier 3, and Tier 4 Calculation Methodologies, perform missing data substitution as follows for each parameter:
  - (1) For each missing value of the high heating value, carbon content, or molecular weight of the fuel, substitute the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If the “after” value has not been

obtained by the time that the GHG emissions report is due, you may use the “before” value for missing data substitution or the best available estimate of the parameter, based on all available process data (e.g., electrical load, steam production, operating hours). If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.

- (2) For missing records of CO<sub>2</sub> concentration, stack gas flow rate, percent moisture, fuel usage, and sorbent usage, the substitute data value shall be the best available estimate of the parameter, based on all available process data (e.g., electrical load, steam production, operating hours, etc.). You must document and retain records of the procedures used for all such estimates.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79150, Dec. 17, 2010]

## § 98.36 Data reporting requirements.

- (a) In addition to the facility-level information required under § 98.3, the annual GHG emissions report shall contain the unit-level or process-level data specified in paragraphs (b) through (f) of this section, as applicable, for each stationary fuel combustion source (e.g., individual unit, aggregation of units, common pipe, or common stack) except as otherwise provided in this paragraph (a). For the data specified in paragraphs (b)(9)(iii), (c)(2)(ix), (e)(2)(i), (e)(2)(ii)(A), (e)(2)(ii)(C), (e)(2)(ii)(D), (e)(2)(iv)(A), (e)(2)(iv)(C), (e)(2)(iv)(F), and (e)(2)(ix)(D) through (F) of this section, the owner or operator of a stationary fuel combustion source that does not meet the criteria specified in paragraph (f) of this section may elect either to report the data specified in this sentence in the annual report or to use verification software according to § 98.5(b) in lieu of reporting these data. If you elect to use this verification software, you must use the verification software according to § 98.5(b) for all of these data that apply to the stationary fuel combustion source.
- (b) **Units that use the four tiers.** You shall report the following information for stationary combustion units that use the Tier 1, Tier 2, Tier 3, or Tier 4 methodology in § 98.33(a) to calculate CO<sub>2</sub> emissions, except as otherwise provided in paragraphs (c) and (d) of this section:
  - (1) The unit ID number.
  - (2) A code representing the type of unit.
  - (3) Maximum rated heat input capacity of the unit, in mmBtu/hr.
  - (4) Each type of fuel combusted in the unit during the report year.
  - (5) The methodology (i.e., tier) used to calculate the CO<sub>2</sub> emissions for each type of fuel combusted (i.e., Tier 1, 2, 3, or 4).
  - (6) The methodology start date, for each fuel type.
  - (7) The methodology end date, for each fuel type.
  - (8) For a unit that uses Tiers 1, 2, or 3:
    - (i) The annual CO<sub>2</sub> mass emissions (including biogenic CO<sub>2</sub>), and the annual CH<sub>4</sub>, and N<sub>2</sub>O mass emissions for each type of fuel combusted during the reporting year, expressed in metric tons of each gas and in metric tons of CO<sub>2</sub>e; and
    - (ii) Metric tons of biogenic CO<sub>2</sub> emissions (if applicable).

(9) For a unit that uses Tier 4:

- (i) If the total annual CO<sub>2</sub> mass emissions measured by the CEMS consists entirely of non-biogenic CO<sub>2</sub> (i.e., CO<sub>2</sub> from fossil fuel combustion plus, if applicable, CO<sub>2</sub> from sorbent and/or process CO<sub>2</sub>), report the total annual CO<sub>2</sub> mass emissions, expressed in metric tons. You are not required to report the combustion CO<sub>2</sub> emissions by fuel type.
- (ii) Report the total annual CO<sub>2</sub> mass emissions measured by the CEMS. If this total includes both biogenic and non-biogenic CO<sub>2</sub>, separately report the annual non-biogenic CO<sub>2</sub> mass emissions and the annual CO<sub>2</sub> mass emissions from biomass combustion, each expressed in metric tons. You are not required to report the combustion CO<sub>2</sub> emissions by fuel type.
- (iii) An estimate of the heat input from each type of fuel listed in Table C-2 of this subpart that was combusted in the unit during the report year.
- (iv) The annual CH<sub>4</sub> and N<sub>2</sub>O emissions for each type of fuel listed in Table C-2 of this subpart that was combusted in the unit during the report year, expressed in metric tons of each gas and in metric tons of CO<sub>2</sub>e.

(10) Annual CO<sub>2</sub> emissions from sorbent (if calculated using Equation C-11 of this subpart), expressed in metric tons.

(11) If applicable, the plant code (as defined in § 98.6).

(12) For natural gas-fired reciprocating internal combustion engines or gas turbines at facilities subject to subpart W of this part, which must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4), you must also report:

- (i) Type of equipment (i.e., two-stroke lean-burn reciprocating internal combustion engine, four-stroke lean-burn reciprocating internal combustion engine, four-stroke rich-burn reciprocating internal combustion engine, or gas turbine).
- (ii) Method by which the CH<sub>4</sub> emission factor was determined: performance test, manufacturer data, or default emission factor.
- (iii) Value of the CH<sub>4</sub> emission factor.

(c) **Reporting alternatives for units using the four Tiers.** You may use any of the applicable reporting alternatives of this paragraph to simplify the unit-level reporting required under paragraph (b) of this section:

(1) **Aggregation of units.** If a facility contains two or more units (e.g., boilers or combustion turbines), each of which has a maximum rated heat input capacity of 250 mmBtu/hr or less, you may report the combined GHG emissions for the group of units in lieu of reporting GHG emissions from the individual units, provided that the use of Tier 4 is not required or elected for any of the units and the units use the same tier for any common fuels combusted. If this option is selected, the following information shall be reported instead of the information in paragraph (b) of this section:

- (i) Group ID number, beginning with the prefix "GP".
- (ii) [Reserved]
- (iii) Cumulative maximum rated heat input capacity of the group (mmBtu/hr). The cumulative maximum rated heat input capacity shall be determined as the sum of the maximum rated heat input capacities for all units in the group, excluding units less than 10 (mmBtu/hr).

- (iv) The highest maximum rated heat input capacity of any unit in the group (mmBtu/hr).
- (v) Each type of fuel combusted in the group of units during the reporting year.
- (vi) Annual CO<sub>2</sub> mass emissions and annual CH<sub>4</sub>, and N<sub>2</sub>O mass emissions, aggregated for each type of fuel combusted in the group of units during the report year, expressed in metric tons of each gas and in metric tons of CO<sub>2</sub>e. If any of the units burn biomass, report also the annual CO<sub>2</sub> emissions from combustion of all biomass fuels combined, expressed in metric tons.
- (vii) The methodology (*i.e.*, tier) used to calculate the CO<sub>2</sub> mass emissions for each type of fuel combusted in the units (*i.e.*, Tier 1, Tier 2, or Tier 3).
- (viii) The methodology start date, for each fuel type.
- (ix) The methodology end date, for each fuel type.
- (x) The calculated CO<sub>2</sub> mass emissions (if any) from sorbent expressed in metric tons.
- (xi) If applicable, the plant code (as defined in § 98.6).
- (xii) For natural gas-fired reciprocating internal combustion engines or gas turbines at facilities subject to subpart W of this part, which must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4), you must report the equipment type (*i.e.*, two-stroke lean-burn reciprocating internal combustion engine, four-stroke lean-burn reciprocating internal combustion engine, four-stroke rich-burn reciprocating internal combustion engine, and gas turbine), the method by which the CH<sub>4</sub> emission factor was determined (*i.e.*, performance test, manufacturer data, or default emission factor), and the average value of the CH<sub>4</sub> emission factor.

(2) **Monitored common stack or duct configurations.** When the flue gases from two or more stationary fuel combustion units at a facility are combined together in a common stack or duct before exiting to the atmosphere and if CEMS are used to continuously monitor CO<sub>2</sub> mass emissions at the common stack or duct according to the Tier 4 Calculation Methodology, you may report the combined emissions from the units sharing the common stack or duct, in lieu of separately reporting the GHG emissions from the individual units. This monitoring and reporting alternative may also be used when process off-gases or a mixture of combustion products and process gases are combined together in a common stack or duct before exiting to the atmosphere. Whenever the common stack or duct monitoring option is applied, the following information shall be reported instead of the information in paragraph (b) of this section:

- (i) Common stack or duct identification number, beginning with the prefix "CS".
- (ii) Number of units sharing the common stack or duct. Report "1" when the flue gas flowing through the common stack or duct includes combustion products and/or process off-gases, and all of the effluent comes from a single unit (*e.g.*, a furnace, kiln, petrochemical production unit, or smelter).
- (iii) Combined maximum rated heat input capacity of the units sharing the common stack or duct (mmBtu/hr). This data element is required only when all of the units sharing the common stack are stationary fuel combustion units.
- (iv) Each type of fuel combusted in the units during the year.
- (v) The methodology (tier) used to calculate the CO<sub>2</sub> mass emissions, *i.e.*, Tier 4.

- (vi) The methodology start date.
  - (vii) The methodology end date.
  - (viii) Total annual CO<sub>2</sub> mass emissions measured by the CEMS, expressed in metric tons. If any of the units burn both fossil fuels and biomass, separately report the annual non-biogenic CO<sub>2</sub> mass emissions (i.e., CO<sub>2</sub> from fossil fuel combustion plus, if applicable, CO<sub>2</sub> from sorbent and/or process CO<sub>2</sub>) and the annual CO<sub>2</sub> mass emissions from biomass combustion, each expressed in metric tons.
  - (ix) An estimate of the heat input from each type of fuel listed in Table C-2 of this subpart that was combusted in the units sharing the common stack or duct during the report year.
  - (x) For each type of fuel listed in Table C-2 of this subpart that was combusted during the report year in the units sharing the common stack or duct during the report year, the annual CH<sub>4</sub> and N<sub>2</sub>O mass emissions from the units sharing the common stack or duct, expressed in metric tons of each gas and in metric tons of CO<sub>2</sub>e.
  - (xi) If applicable, the plant code (as defined in § 98.6).
- (3) **Common pipe configurations.** When two or more stationary combustion units at a facility combust the same type of liquid or gaseous fuel and the fuel is fed to the individual units through a common supply line or pipe, you may report the combined emissions from the units served by the common supply line, in lieu of separately reporting the GHG emissions from the individual units, provided that the total amount of fuel combusted by the units is accurately measured at the common pipe or supply line using a fuel flow meter, or, for natural gas, the amount of fuel combusted may be obtained from gas billing records. For Tier 3 applications, the flow meter shall be calibrated in accordance with § 98.34(b). If a portion of the fuel measured (or obtained from gas billing records) at the main supply line is diverted to either: A flare; or another stationary fuel combustion unit (or units), including units that use a CO<sub>2</sub> mass emissions calculation method in part 75 of this chapter; or a chemical or industrial process (where it is used as a raw material but not combusted), and the remainder of the fuel is distributed to a group of combustion units for which you elect to use the common pipe reporting option, you may use company records to subtract out the diverted portion of the fuel from the fuel measured (or obtained from gas billing records) at the main supply line prior to performing the GHG emissions calculations for the group of units using the common pipe option. If the diverted portion of the fuel is combusted, the GHG emissions from the diverted portion shall be accounted for in accordance with the applicable provisions of this part. When the common pipe option is selected, the applicable tier shall be used based on the maximum rated heat input capacity of the largest unit served by the common pipe configuration, except where the applicable tier is based on criteria other than unit size. For example, if the maximum rated heat input capacity of the largest unit is greater than 250 mmBtu/hr, Tier 3 will apply, unless the fuel transported through the common pipe is natural gas or distillate oil, in which case Tier 2 may be used, in accordance with § 98.33(b)(2)(ii). As a second example, in accordance with § 98.33(b)(1)(v), Tier 1 may be used regardless of unit size when natural gas is transported through the common pipe, if the annual fuel consumption is obtained from gas billing records in units of therms or mmBtu. When the common pipe reporting option is selected, the following information shall be reported instead of the information in paragraph (b) of this section:
- (i) Common pipe identification number, beginning with the prefix "CP".

- (ii) Cumulative maximum rated heat input capacity of the units served by the common pipe (mmBtu/hr). The cumulative maximum rated heat input capacity shall be determined as the sum of the maximum rated heat input capacities for all units served by the common pipe, excluding units less than 10 (mmBtu/hr).
  - (iii) The highest maximum rated heat input capacity of any unit served by the common pipe (mmBtu/hr).
  - (iv) The fuels combusted in the units during the reporting year.
  - (v) The methodology used to calculate the CO<sub>2</sub> mass emissions (i.e., Tier 1, Tier 2, or Tier 3).
  - (vi) If any of the units burns biomass, the annual CO<sub>2</sub> emissions from combustion of all biomass fuels from the units served by the common pipe, expressed in metric tons.
  - (vii) Annual CO<sub>2</sub> mass emissions and annual CH<sub>4</sub> and N<sub>2</sub>O emissions from each fuel type for the units served by the common pipe, expressed in metric tons of each gas and in metric tons of CO<sub>2</sub>e.
  - (viii) Methodology start date.
  - (ix) Methodology end date.
  - (x) If applicable, the plant code (as defined in § 98.6).
  - (xi) For natural gas-fired reciprocating internal combustion engines or gas turbines at facilities subject to subpart W of this part, which must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4), you must report the equipment type (i.e., two-stroke lean-burn reciprocating internal combustion engine, four-stroke lean-burn reciprocating internal combustion engine, four-stroke rich-burn reciprocating internal combustion engine, and gas turbine) the method by which the CH<sub>4</sub> emission factor was determined (i.e., performance test, manufacturer data, or default emission factor), and the average value of the CH<sub>4</sub> emission factor.
- (4) The following alternative reporting option applies to facilities at which a common liquid or gaseous fuel supply is shared between one or more large combustion units, such as boilers or combustion turbines (including units subject to subpart D of this part and other units subject to part 75 of this chapter) and small combustion sources, including, but not limited to, space heaters, hot water heaters, and lab burners. In this case, you may simplify reporting by attributing all of the GHG emissions from combustion of the shared fuel to the large combustion unit(s), provided that:
- (i) The total quantity of the fuel combusted during the report year in the units sharing the fuel supply is measured, either at the “gate” to the facility or at a point inside the facility, using a fuel flow meter, billing meter, or tank drop measurements (as applicable);
  - (ii) On an annual basis, at least 95 percent (by mass or volume) of the shared fuel is combusted in the large combustion unit(s), and the remainder is combusted in the small combustion sources. Company records may be used to determine the percentage distribution of the shared fuel to the large and small units; and

- (iii) The use of this reporting option is documented in the Monitoring Plan required under § 98.3(g)(5). Indicate in the Monitoring Plan which units share the common fuel supply and the method used to demonstrate that this alternative reporting option applies. For the small combustion sources, a description of the types of units and the approximate number of units is sufficient.

(d) *Units subject to part 75 of this chapter.*

- (1) For stationary combustion units that are subject to subpart D of this part, you shall report the following unit-level information:
  - (i) Unit or stack identification numbers. Use exact same unit, common stack, common pipe, or multiple stack identification numbers that represent the monitored locations (e.g., 1, 2, CS001, MS1A, CP001, etc.) that are reported under § 75.64 of this chapter.
  - (ii) Annual CO<sub>2</sub> emissions at each monitored location, expressed in both short tons and metric tons. Separate reporting of biogenic CO<sub>2</sub> emissions under § 98.3(c)(4)(ii) and § 98.3(c)(4)(iii)(A) is optional only for the 2010 reporting year, as provided in § 98.3(c)(12).
  - (iii) Annual CH<sub>4</sub> and N<sub>2</sub>O emissions at each monitored location, for each fuel type listed in Table C-2 that was combusted during the year (except as otherwise provided in § 98.33(c)(4)(ii)(B)), expressed in metric tons of CO<sub>2</sub>e.
  - (iv) The total heat input from each fuel listed in Table C-2 that was combusted during the year (except as otherwise provided in § 98.33(c)(4)(ii)(B)), expressed in mmBtu.
  - (v) Identification of the Part 75 methodology used to determine the CO<sub>2</sub> mass emissions.
  - (vi) Methodology start date.
  - (vii) Methodology end date.
  - (viii) Acid Rain Program indicator.
  - (ix) Annual CO<sub>2</sub> mass emissions from the combustion of biomass, expressed in metric tons of CO<sub>2</sub>e, except where the reporting provisions of §§ 98.3(c)(12)(i) through (c)(12)(iii) are implemented for the 2010 reporting year.
  - (x) If applicable, the plant code (as defined in § 98.6).
- (2) For units that use the alternative CO<sub>2</sub> mass emissions calculation methods provided in § 98.33(a)(5), you shall report the following unit-level information:
  - (i) Unit, stack, or pipe ID numbers. Use exact same unit, common stack, common pipe, or multiple stack identification numbers that represent the monitored locations (e.g., 1, 2, CS001, MS1A, CP001, etc.) that are reported under § 75.64 of this chapter.
  - (ii) For units that use the alternative methods specified in § 98.33(a)(5)(i) and (ii) to monitor and report heat input data year-round according to appendix D to part 75 of this chapter or § 75.19 of this chapter:
    - (A) Each type of fuel combusted in the unit during the reporting year.
    - (B) The methodology used to calculate the CO<sub>2</sub> mass emissions for each fuel type.
    - (C) Methodology start date.

- (D) Methodology end date.
  - (E) A code or flag to indicate whether heat input is calculated according to appendix D to part 75 of this chapter or § 75.19 of this chapter.
  - (F) Annual CO<sub>2</sub> emissions at each monitored location, across all fuel types, expressed in metric tons of CO<sub>2</sub>e.
  - (G) Annual heat input from each type of fuel listed in Table C-2 of this subpart that was combusted during the reporting year, expressed in mmBtu.
  - (H) Annual CH<sub>4</sub> and N<sub>2</sub>O emissions at each monitored location, from each fuel type listed in Table C-2 of this subpart that was combusted during the reporting year (except as otherwise provided in § 98.33(c)(4)(ii)(D)), expressed in metric tons CO<sub>2</sub>e.
  - (I) Annual CO<sub>2</sub> mass emissions from the combustion of biomass, expressed in metric tons CO<sub>2</sub>e, except where the reporting provisions of §§ 98.3(c)(12)(i) through (c)(12)(iii) are implemented for the 2010 reporting year.
  - (J) If applicable, the plant code (as defined in § 98.6).
- (iii) For units with continuous monitoring systems that use the alternative method for units with continuous monitoring systems in § 98.33(a)(5)(iii) to monitor heat input year-round according to part 75 of this chapter:
- (A) Each type of fuel combusted during the reporting year.
  - (B) Methodology used to calculate the CO<sub>2</sub> mass emissions.
  - (C) Methodology start date.
  - (D) Methodology end date.
  - (E) A code or flag to indicate that the heat input data is derived from CEMS measurements.
  - (F) The total annual CO<sub>2</sub> emissions at each monitored location, expressed in metric tons of CO<sub>2</sub>e.
  - (G) Annual heat input from each type of fuel listed in Table C-2 of this subpart that was combusted during the reporting year, expressed in mmBtu.
  - (H) Annual CH<sub>4</sub> and N<sub>2</sub>O emissions at each monitored location, from each fuel type listed in Table C-2 of this subpart that was combusted during the reporting year (except as otherwise provided in § 98.33(c)(4)(ii)(B)), expressed in metric tons CO<sub>2</sub>e.
  - (I) Annual CO<sub>2</sub> mass emissions from the combustion of biomass, expressed in metric tons CO<sub>2</sub>e, except where the reporting provisions of §§ 98.3(c)(12)(i) through (c)(12)(iii) are implemented for the 2010 reporting year.
  - (J) If applicable, the plant code (as defined in § 98.6).
- (e) **Verification data.** You must keep on file, in a format suitable for inspection and auditing, sufficient data to verify the reported GHG emissions. This data and information must, where indicated in this paragraph (e), be included in the annual GHG emissions report.
- (1) The applicable verification data specified in this paragraph (e) are not required to be kept on file or reported for units that meet any one of the three following conditions:



- (i) Are subject to the Acid Rain Program.
  - (ii) Use the alternative methods for units with continuous monitoring systems provided in § 98.33(a)(5).
  - (iii) Are not in the Acid Rain Program, but are required to monitor and report CO<sub>2</sub> mass emissions and heat input data year-round, in accordance with part 75 of this chapter.
- (2) For stationary combustion sources using the Tier 1, Tier 2, Tier 3, and Tier 4 Calculation Methodologies in § 98.33(a) to quantify CO<sub>2</sub> emissions, the following additional information shall be kept on file and included in the GHG emissions report, where indicated:
  - (i) For the Tier 1 Calculation Methodology, report:
    - (A) The total quantity of each type of fuel combusted in the unit or group of aggregated units (as applicable) during the reporting year, in short tons for solid fuels, gallons for liquid fuels and standard cubic feet for gaseous fuels, or, if applicable, therms or mmBtu for natural gas.
    - (B) If applicable, the moisture content used to calculate the wood and wood residuals wet basis HHV for use in Equations C-1 and C-8 of this subpart, in percent.
  - (ii) For the Tier 2 Calculation Methodology, report:
    - (A) The total quantity of each type of fuel combusted in the unit or group of aggregated units (as applicable) during each month of the reporting year. Express the quantity of each fuel combusted during the measurement period in short tons for solid fuels, gallons for liquid fuels, and scf for gaseous fuels.
    - (B) The frequency of the HHV determinations (e.g., once a month, once per fuel lot).
    - (C) The annual average, and, where applicable, monthly high heat values used in the CO<sub>2</sub> emissions calculations for each type of fuel combusted during the reporting year, in mmBtu per short ton for solid fuels, mmBtu per gallon for liquid fuels, and mmBtu per scf for gaseous fuels. Report an HHV value for each calendar month in which HHV determination is required. If multiple values are obtained in a given month, report the arithmetic average value for the month.
    - (D) If Equation C-2c of this subpart is used to calculate CO<sub>2</sub> mass emissions, report the total quantity (*i.e.*, pounds) of steam produced from MSW or solid fuel combustion during each month of the reporting year, and the ratio of the maximum rate heat input capacity to the design rated steam output capacity of the unit, in mmBtu per lb of steam.
    - (E) For each HHV used in the CO<sub>2</sub> emissions calculations for each type of fuel combusted during the reporting year, indicate whether the HHV is a measured value or a substitute data value.
  - (iii) For the Tier 2 Calculation Methodology, keep records of the methods used to determine the HHV for each type of fuel combusted and the date on which each fuel sample was taken, except where fuel sampling data are received from the fuel supplier. In that case, keep records of the dates on which the results of the fuel analyses for HHV are received.
  - (iv) For the Tier 3 Calculation Methodology, report:

- (A) The quantity of each type of fuel combusted in the unit or group of units (as applicable) during each month of the reporting year, in short tons for solid fuels, gallons for liquid fuels, and scf for gaseous fuels.
- (B) The frequency of carbon content and, if applicable, molecular weight determinations for each type of fuel for the reporting year (e.g., daily, weekly, monthly, semiannually, once per fuel lot).
- (C) The carbon content and, if applicable, gas molecular weight values used in the emission calculations (including both valid and substitute data values). For each calendar month of the reporting year in which carbon content and, if applicable, molecular weight determination is required, report a value of each parameter. If multiple values of a parameter are obtained in a given month, report the arithmetic average value for the month. Express carbon content as a decimal fraction for solid fuels, kg C per gallon for liquid fuels, and kg C per kg of fuel for gaseous fuels. Express the gas molecular weights in units of kg per kg-mole.
- (D) The total number of valid carbon content determinations and, if applicable, molecular weight determinations made during the reporting year, for each fuel type.
- (E) The number of substitute data values used for carbon content and, if applicable, molecular weight used in the annual GHG emissions calculations.
- (F) The annual average HHV, when measured HHV data, rather than a default HHV from Table C-1 of this subpart, are used to calculate CH<sub>4</sub> and N<sub>2</sub>O emissions for a Tier 3 unit, in accordance with § 98.33(c)(1).
- (G) The value of the molar volume constant (MVC) used in Equation C-5 (if applicable).
- (v) For the Tier 3 Calculation Methodology, keep records of the following:
  - (A) For liquid and gaseous fuel combustion, the dates and results of the initial calibrations and periodic recalibrations of the required fuel flow meters.
  - (B) For fuel oil combustion, the method from § 98.34(b) used to make tank drop measurements (if applicable).
  - (C) The methods used to determine the carbon content and (if applicable) the molecular weight of each type of fuel combusted.
  - (D) The methods used to calibrate the fuel flow meters).
  - (E) The date on which each fuel sample was taken, except where fuel sampling data are received from the fuel supplier. In that case, keep records of the dates on which the results of the fuel analyses for carbon content and (if applicable) molecular weight are received.
- (vi) For the Tier 4 Calculation Methodology, report:
  - (A) The total number of source operating hours in the reporting year.
  - (B) The cumulative CO<sub>2</sub> mass emissions in each quarter of the reporting year, i.e., the sum of the hourly values calculated from Equation C-6 or C-7 of this subpart (as applicable), in metric tons.

- (C) For CO<sub>2</sub> concentration, stack gas flow rate, and (if applicable) stack gas moisture content, the percentage of source operating hours in which a substitute data value of each parameter was used in the emissions calculations.
- (vii) For the Tier 4 Calculation Methodology, keep records of:
  - (A) Whether the CEMS certification and quality assurance procedures of part 75 of this chapter, part 60 of this chapter, or an applicable State continuous monitoring program were used.
  - (B) The dates and results of the initial certification tests of the CEMS.
  - (C) The dates and results of the major quality assurance tests performed on the CEMS during the reporting year, i.e., linearity checks, cylinder gas audits, and relative accuracy test audits (RATAs).
- (viii) If CO<sub>2</sub> emissions that are generated from acid gas scrubbing with sorbent injection are not captured using CEMS, report:
  - (A) The total amount of sorbent used during the report year, in short tons.
  - (B) The molecular weight of the sorbent.
  - (C) The ratio ("R") in Equation C-11 of this subpart.
- (ix) For units that combust both fossil fuel and biomass, when biogenic CO<sub>2</sub> is determined according to § 98.33(e)(2), you shall report the following additional information, as applicable:
  - (A) The annual volume of CO<sub>2</sub> emitted from the combustion of all fuels, i.e.,  $V_{\text{total}}$ , in scf.
  - (B) The annual volume of CO<sub>2</sub> emitted from the combustion of fossil fuels, i.e.,  $V_{\text{ff}}$ , in scf. If more than one type of fossil fuel was combusted, report the combustion volume of CO<sub>2</sub> for each fuel separately as well as the total.
  - (C) The annual volume of CO<sub>2</sub> emitted from the combustion of biomass, i.e.,  $V_{\text{bio}}$ , in scf.
  - (D) The carbon-based F-factor used in Equation C-13 of this subpart, for each type of fossil fuel combusted, in scf CO<sub>2</sub> per mmBtu.
  - (E) The annual average HHV value used in Equation C-13 of this subpart, for each type of fossil fuel combusted, in Btu/lb, Btu/gal, or Btu/scf, as appropriate.
  - (F) The total quantity of each type of fossil fuel combusted during the reporting year, in lb, gallons, or scf, as appropriate.
  - (G) Annual biogenic CO<sub>2</sub> mass emissions, in metric tons.
- (x) When ASTM methods D7459-08 and D6866-16 (both incorporated by reference, see § 98.7) are used to determine the biogenic portion of the annual CO<sub>2</sub> emissions from MSW combustion, as described in § 98.34(d), report:
  - (A) The results of each quarterly sample analysis, expressed as a decimal fraction (e.g., if the biogenic fraction of the CO<sub>2</sub> emissions from MSW combustion is 30 percent, report 0.30).
  - (B) The annual biogenic CO<sub>2</sub> mass emissions from MSW combustion, in metric tons.

- (xi) When ASTM methods D7459-08 and D6866-16 (both incorporated by reference, see § 98.7) are used in accordance with § 98.34(e) to determine the biogenic portion of the annual CO<sub>2</sub> emissions from a unit that co-fires biogenic fuels (or partly-biogenic fuels, including tires) and non-biogenic fuels, you shall report the results of each quarterly sample analysis, expressed as a decimal fraction (e.g., if the biogenic fraction of the CO<sub>2</sub> emissions is 30 percent, report 0.30).
- (3) Within 30 days of receipt of a written request from the Administrator, you shall submit explanations of the following:
  - (i) An explanation of how company records are used to quantify fuel consumption, if the Tier 1 or Tier 2 Calculation Methodology is used to calculate CO<sub>2</sub> emissions.
  - (ii) An explanation of how company records are used to quantify fuel consumption, if solid fuel is combusted and the Tier 3 Calculation Methodology is used to calculate CO<sub>2</sub> emissions.
  - (iii) An explanation of how sorbent usage is quantified.
  - (iv) An explanation of how company records are used to quantify fossil fuel consumption in units that uses CEMS to quantify CO<sub>2</sub> emissions and combusts both fossil fuel and biomass.
  - (v) An explanation of how company records are used to measure steam production, when it is used to calculate CO<sub>2</sub> mass emissions under § 98.33(a)(2)(iii) or to quantify solid fuel usage under § 98.33(c)(3).
- (4) Within 30 days of receipt of a written request from the Administrator, you shall submit the verification data and information described in paragraphs (e)(2)(iii), (e)(2)(v), and (e)(2)(vii) of this section.
- (f) Each stationary fuel combustion source (e.g., individual unit, aggregation of units, common pipe, or common stack) subject to reporting under paragraph (b) or (c) of this section must indicate if both of the following two conditions are met:
  - (1) The stationary fuel combustion source contains at least one combustion unit connected to a fuel-fired electric generator owned or operated by an entity that is subject to regulation of customer billing rates by the public utility commission (excluding generators that are connected to combustion units that are subject to subpart D of this part).
  - (2) The stationary fuel combustion source is located at a facility for which the sum of the nameplate capacities for all electric generators specified in paragraph (f)(1) of this section is greater than or equal to 1 megawatt electric output.

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### § 98.37 Records that must be retained.

In addition to the requirements of § 98.3(g), you must retain:

- (a) The applicable records specified in §§ 98.34(f), 98.35(b), and 98.36(e).
- (b) The applicable verification software records as identified in this paragraph (b). For each stationary fuel combustion source that elects to use the verification software specified in § 98.5(b) rather than report data specified in paragraphs (b)(9)(iii), (c)(2)(ix), (e)(2)(i), (e)(2)(ii)(A), (C), and (D), (e)(2)(iv)(A), (C), and (F), and (e)(2)(ix)(D) through (F) of this section, you must keep a record of the file generated by the

verification software for the applicable data specified in paragraphs (b)(1) through (37) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (b)(1) through (37) of this section.

- (1) Mass of each solid fuel combusted (tons/year) (equation C-1 to § 98.33).
- (2) Volume of each liquid fuel combusted (gallons/year) (equation C-1 to § 98.33).
- (3) Volume of each gaseous fuel combusted (scf/year) (equation C-1 to § 98.33).
- (4) Annual natural gas usage (therms/year) (equation C-1a to § 98.33).
- (5) Annual natural gas usage (mmBtu/year) (equation C-1b to § 98.33).
- (6) Mass of each solid fuel combusted (tons/year) (equation C-2a to § 98.33).
- (7) Volume of each liquid fuel combusted (gallons/year) (equation C-2a to § 98.33).
- (8) Volume of each gaseous fuel combusted (scf/year) (equation C-2a to § 98.33).
- (9) Measured high heat value of each solid fuel, for month (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (mmBtu per ton) (equation C-2b to § 98.33). Annual average HHV of each solid fuel (mmBtu per ton) (equation C-2a to § 98.33).
- (10) Measured high heat value of each liquid fuel, for month (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (mmBtu per gallons) (equation C-2b to § 98.33). Annual average HHV of each liquid fuel (mmBtu per gallons) (equation C-2a to § 98.33).
- (11) Measured high heat value of each gaseous fuel, for month (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (mmBtu per scf) (equation C-2b to § 98.33). Annual average HHV of each gaseous fuel (mmBtu per scf) (equation C-2a to § 98.33).
- (12) Mass of each solid fuel combusted during month (tons) (equation C-2b to § 98.33).
- (13) Volume of each liquid fuel combusted during month (gallons) (equation C-2b to § 98.33).
- (14) Volume of each gaseous fuel combusted during month (scf) (equation C-2b, equation C-5A, equation C-5B to § 98.33).
- (15) Total mass of steam generated by municipal solid waste or each solid fuel combustion during the reporting year (pounds steam) (equation C-2c to § 98.33).
- (16) Ratio of the boiler's maximum rated heat input capacity to its design rated steam output capacity (MMBtu/pounds steam) (equation C-2c to § 98.33).
- (17) Annual mass of each solid fuel combusted (short tons/year) (equation C-3 to § 98.33).
- (18) Annual average carbon content of each solid fuel (percent by weight, expressed as a decimal fraction) (equation C-3 to § 98.33). Where applicable, monthly carbon content of each solid fuel (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (percent by weight, expressed as a decimal fraction) (equation C-2b to § 98.33—see the definition of “CC” in equation C-3 to § 98.33).
- (19) Annual volume of each liquid fuel combusted (gallons/year) (equation C-4 to § 98.33).

- (20) Annual average carbon content of each liquid fuel (kg C per gallon of fuel) (equation C-4 to § 98.33). Where applicable, monthly carbon content of each liquid fuel (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (kg C per gallon of fuel) (equation C-2b to § 98.33—see the definition of “CC” in equation C-3 to § 98.33).
- (21) Annual volume of each gaseous fuel combusted (scf/year) (equation C-5 to § 98.33).
- (22) Annual average carbon content of each gaseous fuel (kg C per kg of fuel) (equation C-5 to § 98.33). Where applicable, monthly carbon content of each gaseous (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (kg C per kg of fuel) (equation C-5A to § 98.33).
- (23) Annual average molecular weight of each gaseous fuel (kg/kg-mole) (equation C-5 to § 98.33). Where applicable, monthly molecular weight of each gaseous (which may be the arithmetic average of multiple determinations), or, if applicable, an appropriate substitute data value (kg/kg-mole) (equation C-5B to § 98.33).
- (24) Molar volume conversion factor at standard conditions, as defined in § 98.6 (scf per kg-mole) (equation C-5 to § 98.33).
- (25) Identify for each fuel if you will use the default high heat value from table C-1 to this subpart, or actual high heat value data (equation C-8 to § 98.33).
- (26) High heat value of each solid fuel (mmBtu/tons) (equation C-8 to § 98.33).
- (27) High heat value of each liquid fuel (mmBtu/gallon) (equation C-8 to § 98.33).
- (28) High heat value of each gaseous fuel (mmBtu/scf) (equation C-8 to § 98.33).
- (29) Cumulative annual heat input from combustion of each fuel (mmBtu) (equation C-10 to § 98.33).
- (30) Total quantity of each solid fossil fuel combusted in the reporting year, as defined in § 98.6 (pounds) (equation C-13 to § 98.33).
- (31) Total quantity of each liquid fossil fuel combusted in the reporting year, as defined in § 98.6 (gallons) (equation C-13 to § 98.33).
- (32) Total quantity of each gaseous fossil fuel combusted in the reporting year, as defined in § 98.6 (scf) (equation C-13 to § 98.33).
- (33) High heat value of the each solid fossil fuel (Btu/lb) (equation C-13 to § 98.33).
- (34) High heat value of the each liquid fossil fuel (Btu/gallons) (equation C-13 to § 98.33).
- (35) High heat value of the each gaseous fossil fuel (Btu/scf) (equation C-13 to § 98.33).
- (36) Fuel-specific carbon based F-factor per fuel (scf CO<sub>2</sub>/mmBtu) (equation C-13 to § 98.33).
- (37) Moisture content used to calculate the wood and wood residuals wet basis HHV (percent), if applicable (equations C-1 and C-8 to § 98.33).

[79 FR 63783, Oct. 24, 2014, as amended at 81 FR 89252, Dec. 9, 2016; 89 FR 31903, Apr. 25, 2024]

## § 98.38 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Table C-1 to Subpart C of Part 98—Default CO<sub>2</sub> Emission Factors and High Heat Values for Various Types of Fuel**

**DEFAULT CO<sub>2</sub> EMISSION FACTORS AND HIGH HEAT VALUES FOR VARIOUS TYPES OF FUEL**

| Fuel type                     | Default high heat value | Default CO <sub>2</sub> emission factor |
|-------------------------------|-------------------------|-----------------------------------------|
| Coal and coke                 | mmBtu/short ton         | kg CO <sub>2</sub> /mmBtu               |
| Anthracite                    | 25.09                   | 103.69                                  |
| Bituminous                    | 24.93                   | 93.28                                   |
| Subbituminous                 | 17.25                   | 97.17                                   |
| Lignite                       | 14.21                   | 97.72                                   |
| Coal Coke                     | 24.80                   | 113.67                                  |
| Mixed (Commercial sector)     | 21.39                   | 94.27                                   |
| Mixed (Industrial coking)     | 26.28                   | 93.90                                   |
| Mixed (Industrial sector)     | 22.35                   | 94.67                                   |
| Mixed (Electric Power sector) | 19.73                   | 95.52                                   |
| Natural gas                   | mmBtu/scf               | kg CO <sub>2</sub> /mmBtu               |
| (Weighted U.S. Average)       | $1.026 \times 10^{-3}$  | 53.06                                   |
| Petroleum products—liquid     | mmBtu/gallon            | kg CO <sub>2</sub> /mmBtu               |
| Distillate Fuel Oil No. 1     | 0.139                   | 73.25                                   |
| Distillate Fuel Oil No. 2     | 0.138                   | 73.96                                   |
| Distillate Fuel Oil No. 4     | 0.146                   | 75.04                                   |
| Residual Fuel Oil No. 5       | 0.140                   | 72.93                                   |
| Residual Fuel Oil No. 6       | 0.150                   | 75.10                                   |

<sup>1</sup> The HHV for components of LPG determined at 60 °F and saturation pressure with the exception of ethylene.

<sup>2</sup> Ethylene HHV determined at 41 °F (5 °C) and saturation pressure.

<sup>3</sup> Use of this default HHV is allowed only for: (a) Units that combust MSW, do not generate steam, and are allowed to use Tier 1; (b) units that derive no more than 10 percent of their annual heat input from MSW and/or tires; and (c) small batch incinerators that combust no more than 1,000 tons of MSW per year.

<sup>4</sup> Reporters subject to subpart X of this part that are complying with § 98.243(d) or subpart Y of this part may only use the default HHV and the default CO<sub>2</sub> emission factor for fuel gas combustion under the conditions prescribed in § 98.243(d)(2)(i) and (d)(2)(ii) and § 98.252(a)(1) and (a)(2), respectively. Otherwise, reporters subject to subpart X or subpart Y shall use either Tier 3 (Equation C-5) or Tier 4.

<sup>5</sup> Use the following formula to calculate a wet basis HHV for use in Equation C-1:  $HHV_w = ((100 - M)/100) * HHV_d$  where  $HHV_w$  = wet basis HHV,  $M$  = moisture content (percent) and  $HHV_d$  = dry basis HHV from Table C-1.

| Fuel type                                    | Default high heat value | Default CO <sub>2</sub> emission factor |
|----------------------------------------------|-------------------------|-----------------------------------------|
| Used Oil                                     | 0.138                   | 74.00                                   |
| Kerosene                                     | 0.135                   | 75.20                                   |
| Liquefied petroleum gases (LPG) <sup>1</sup> | 0.092                   | 61.71                                   |
| Propane <sup>1</sup>                         | 0.091                   | 62.87                                   |
| Propylene <sup>2</sup>                       | 0.091                   | 67.77                                   |
| Ethane <sup>1</sup>                          | 0.068                   | 59.60                                   |
| Ethanol                                      | 0.084                   | 68.44                                   |
| Ethylene <sup>2</sup>                        | 0.058                   | 65.96                                   |
| Isobutane <sup>1</sup>                       | 0.099                   | 64.94                                   |
| Isobutylene <sup>1</sup>                     | 0.103                   | 68.86                                   |
| Butane <sup>1</sup>                          | 0.103                   | 64.77                                   |
| Butylene <sup>1</sup>                        | 0.105                   | 68.72                                   |
| Naphtha (<401 deg F)                         | 0.125                   | 68.02                                   |
| Natural Gasoline                             | 0.110                   | 66.88                                   |
| Other Oil (>401 deg F)                       | 0.139                   | 76.22                                   |
| Pentanes Plus                                | 0.110                   | 70.02                                   |
| Petrochemical Feedstocks                     | 0.125                   | 71.02                                   |
| Special Naphtha                              | 0.125                   | 72.34                                   |
| Unfinished Oils                              | 0.139                   | 74.54                                   |
| Heavy Gas Oils                               | 0.148                   | 74.92                                   |
| Lubricants                                   | 0.144                   | 74.27                                   |
| Motor Gasoline                               | 0.125                   | 70.22                                   |
| Aviation Gasoline                            | 0.120                   | 69.25                                   |
| Kerosene-Type Jet Fuel                       | 0.135                   | 72.22                                   |
| Asphalt and Road Oil                         | 0.158                   | 75.36                                   |

<sup>1</sup> The HHV for components of LPG determined at 60 °F and saturation pressure with the exception of ethylene.

<sup>2</sup> Ethylene HHV determined at 41 °F (5 °C) and saturation pressure.

<sup>3</sup> Use of this default HHV is allowed only for: (a) Units that combust MSW, do not generate steam, and are allowed to use Tier 1; (b) units that derive no more than 10 percent of their annual heat input from MSW and/or tires; and (c) small batch incinerators that combust no more than 1,000 tons of MSW per year.

<sup>4</sup> Reporters subject to subpart X of this part that are complying with § 98.243(d) or subpart Y of this part may only use the default HHV and the default CO<sub>2</sub> emission factor for fuel gas combustion under the conditions prescribed in § 98.243(d)(2)(i) and (d)(2)(ii) and § 98.252(a)(1) and (a)(2), respectively. Otherwise, reporters subject to subpart X or subpart Y shall use either Tier 3 (Equation C-5) or Tier 4.

<sup>5</sup> Use the following formula to calculate a wet basis HHV for use in Equation C-1:  $HHV_w = ((100 - M)/100) * HHV_d$  where  $HHV_w$  = wet basis HHV,  $M$  = moisture content (percent) and  $HHV_d$  = dry basis HHV from Table C-1.



| Fuel type                                        | Default high heat value | Default CO <sub>2</sub> emission factor |
|--------------------------------------------------|-------------------------|-----------------------------------------|
| Crude Oil                                        | 0.138                   | 74.54                                   |
| Petroleum products—solid                         | mmBtu/short ton         | kg CO <sub>2</sub> /mmBtu.              |
| Petroleum Coke                                   | 30.00                   | 102.41.                                 |
| Petroleum products—gaseous                       | mmBtu/scf               | kg CO <sub>2</sub> /mmBtu.              |
| Propane Gas                                      | $2.516 \times 10^{-3}$  | 61.46.                                  |
| Other fuels—solid                                | mmBtu/short ton         | kg CO <sub>2</sub> /mmBtu               |
| Municipal Solid Waste                            | $9.95^3$                | 90.7                                    |
| Tires                                            | 28.00                   | 85.97                                   |
| Plastics                                         | 38.00                   | 75.00                                   |
| Other fuels—gaseous                              | mmBtu/scf               | kg CO <sub>2</sub> /mmBtu               |
| Blast Furnace Gas                                | $0.092 \times 10^{-3}$  | 274.32                                  |
| Coke Oven Gas                                    | $0.599 \times 10^{-3}$  | 46.85                                   |
| Fuel Gas <sup>4</sup>                            | $1.388 \times 10^{-3}$  | 59.00                                   |
| Biomass fuels—solid                              | mmBtu/short ton         | kg CO <sub>2</sub> /mmBtu               |
| Wood and Wood Residuals (dry basis) <sup>5</sup> | 17.48                   | 93.80                                   |
| Agricultural Byproducts                          | 8.25                    | 118.17                                  |
| Peat                                             | 8.00                    | 111.84                                  |
| Solid Byproducts                                 | 10.39                   | 105.51                                  |
| Biomass fuels—gaseous                            | mmBtu/scf               | kg CO <sub>2</sub> /mmBtu               |
| Landfill Gas                                     | $0.485 \times 10^{-3}$  | 52.07                                   |
| Other Biomass Gases                              | $0.655 \times 10^{-3}$  | 52.07                                   |
| Biomass Fuels—Liquid                             | mmBtu/gallon            | kg CO <sub>2</sub> /mmBtu               |
| Ethanol                                          | 0.084                   | 68.44                                   |
| Biodiesel (100%)                                 | 0.128                   | 73.84                                   |

<sup>1</sup> The HHV for components of LPG determined at 60 °F and saturation pressure with the exception of ethylene.

<sup>2</sup> Ethylene HHV determined at 41 °F (5 °C) and saturation pressure.

<sup>3</sup> Use of this default HHV is allowed only for: (a) Units that combust MSW, do not generate steam, and are allowed to use Tier 1; (b) units that derive no more than 10 percent of their annual heat input from MSW and/or tires; and (c) small batch incinerators that combust no more than 1,000 tons of MSW per year.

<sup>4</sup> Reporters subject to subpart X of this part that are complying with § 98.243(d) or subpart Y of this part may only use the default HHV and the default CO<sub>2</sub> emission factor for fuel gas combustion under the conditions prescribed in § 98.243(d)(2)(i) and (d)(2)(ii) and § 98.252(a)(1) and (a)(2), respectively. Otherwise, reporters subject to subpart X or subpart Y shall use either Tier 3 (Equation C-5) or Tier 4.

<sup>5</sup> Use the following formula to calculate a wet basis HHV for use in Equation C-1:  $HHV_w = ((100 - M)/100) * HHV_d$  where  $HHV_w$  = wet basis HHV,  $M$  = moisture content (percent) and  $HHV_d$  = dry basis HHV from Table C-1.

| Fuel type           | Default high heat value | Default CO <sub>2</sub> emission factor |
|---------------------|-------------------------|-----------------------------------------|
| Rendered Animal Fat | 0.125                   | 71.06                                   |
| Vegetable Oil       | 0.120                   | 81.55                                   |

<sup>1</sup> The HHV for components of LPG determined at 60 °F and saturation pressure with the exception of ethylene.

<sup>2</sup> Ethylene HHV determined at 41 °F (5 °C) and saturation pressure.

<sup>3</sup> Use of this default HHV is allowed only for: (a) Units that combust MSW, do not generate steam, and are allowed to use Tier 1; (b) units that derive no more than 10 percent of their annual heat input from MSW and/or tires; and (c) small batch incinerators that combust no more than 1,000 tons of MSW per year.

<sup>4</sup> Reporters subject to subpart X of this part that are complying with § 98.243(d) or subpart Y of this part may only use the default HHV and the default CO<sub>2</sub> emission factor for fuel gas combustion under the conditions prescribed in § 98.243(d)(2)(i) and (d)(2)(ii) and § 98.252(a)(1) and (a)(2), respectively. Otherwise, reporters subject to subpart X or subpart Y shall use either Tier 3 (Equation C-5) or Tier 4.

<sup>5</sup> Use the following formula to calculate a wet basis HHV for use in Equation C-1:  $HHV_w = ((100 - M)/100) * HHV_d$  where  $HHV_w$  = wet basis HHV, M = moisture content (percent) and  $HHV_d$  = dry basis HHV from Table C-1.

[78 FR 71950, Nov. 29, 2013, as amended at 81 FR 89252, Dec. 9, 2016]

**Table C-2 to Subpart C of Part 98—Default CH<sub>4</sub> and N<sub>2</sub>O Emission Factors for Various Types of Fuel**

| Fuel type                                        | Default CH <sub>4</sub> emission factor (kg CH <sub>4</sub> /mmBtu) | Default N <sub>2</sub> O emission factor (kg N <sub>2</sub> O/mmBtu) |
|--------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|
| Coal and Coke (All fuel types in Table C-1)      | $1.1 \times 10^{-02}$                                               | $1.6 \times 10^{-03}$                                                |
| Natural Gas <sup>1</sup>                         | $1.0 \times 10^{-03}$                                               | $1.0 \times 10^{-04}$                                                |
| Petroleum Products (All fuel types in Table C-1) | $3.0 \times 10^{-03}$                                               | $6.0 \times 10^{-04}$                                                |

Note: Those employing this table are assumed to fall under the IPCC definitions of the “Energy Industry” or “Manufacturing Industries and Construction”. In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC “Energy Industry” category may employ a value of 1g of CH<sub>4</sub>/mmBtu.

<sup>1</sup> Reporters subject to subpart W of this part may only use the default CH<sub>4</sub> emission factor for natural gas-fired combustion units that are not reciprocating internal combustion engines or gas turbines. For natural gas-fired reciprocating internal combustion engines or gas turbines, at facilities subject to subpart W of this part, reporters must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4).

| Fuel type                                                                         | Default CH <sub>4</sub> emission factor (kg CH <sub>4</sub> /mmBtu) | Default N <sub>2</sub> O emission factor (kg N <sub>2</sub> O/mmBtu) |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|
| Fuel Gas                                                                          | $3.0 \times 10^{-03}$                                               | $6.0 \times 10^{-04}$                                                |
| Other Fuels—Solid                                                                 | $3.2 \times 10^{-02}$                                               | $4.2 \times 10^{-03}$                                                |
| Blast Furnace Gas                                                                 | $2.2 \times 10^{-05}$                                               | $1.0 \times 10^{-04}$                                                |
| Coke Oven Gas                                                                     | $4.8 \times 10^{-04}$                                               | $1.0 \times 10^{-04}$                                                |
| Biomass Fuels—Solid (All fuel types in Table C-1, except wood and wood residuals) | $3.2 \times 10^{-02}$                                               | $4.2 \times 10^{-03}$                                                |
| Wood and wood residuals                                                           | $7.2 \times 10^{-03}$                                               | $3.6 \times 10^{-03}$                                                |
| Biomass Fuels—Gaseous (All fuel types in Table C-1)                               | $3.2 \times 10^{-03}$                                               | $6.3 \times 10^{-04}$                                                |
| Biomass Fuels—Liquid (All fuel types in Table C-1)                                | $1.1 \times 10^{-03}$                                               | $1.1 \times 10^{-04}$                                                |

*Note: Those employing this table are assumed to fall under the IPCC definitions of the “Energy Industry” or “Manufacturing Industries and Construction”. In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC “Energy Industry” category may employ a value of 1g of CH<sub>4</sub>/mmBtu.*

<sup>1</sup> Reporters subject to subpart W of this part may only use the default CH<sub>4</sub> emission factor for natural gas-fired combustion units that are not reciprocating internal combustion engines or gas turbines. For natural gas-fired reciprocating internal combustion engines or gas turbines, at facilities subject to subpart W of this part, reporters must use a CH<sub>4</sub> emission factor determined in accordance with § 98.233(z)(4).

[78 FR 71952, Nov. 29, 2013, as amended at 81 FR 89252, Dec. 9, 2016; 89 FR 42220, May 14, 2024]

## Subpart D—Electricity Generation

### § 98.40 Definition of the source category.

- (a) The electricity generation source category comprises electricity generating units that are subject to the requirements of the Acid Rain Program and any other electricity generating units that are required to monitor and report to EPA CO<sub>2</sub> mass emissions year-round according to 40 CFR part 75.
- (b) This source category does not include portable equipment, emergency equipment, or emergency generators, as defined in § 98.6.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79155, Dec. 17, 2010]

### § 98.41 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains one or more electricity generating units and the facility meets the requirements of § 98.2(a)(1).

## § 98.42 GHGs to report.

- (a) For each electricity generating unit that is subject to the requirements of the Acid Rain Program or is otherwise required to monitor and report to EPA CO<sub>2</sub> emissions year-round according to 40 CFR part 75, you must report under this subpart the annual mass emissions of CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub> by following the requirements of this subpart.
- (b) For each electricity generating unit that is not subject to the Acid Rain Program or otherwise required to monitor and report to EPA CO<sub>2</sub> emissions year-round according to 40 CFR part 75, you must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O by following the requirements of subpart C.
- (c) For each stationary fuel combustion unit that does not generate electricity, you must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O by following the requirements of subpart C of this part.

## § 98.43 Calculating GHG emissions.

- (a) Except as provided in paragraph (b) of this section, continue to monitor and report CO<sub>2</sub> mass emissions as required under § 75.13 or section 2.3 of appendix G to 40 CFR part 75, and § 75.64. Calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions as follows:
  - (1) Convert the cumulative annual CO<sub>2</sub> mass emissions reported in the fourth quarter electronic data report required under § 75.64 from units of short tons to metric tons. To convert tons to metric tons, divide by 1.1023.
  - (2) Calculate and report annual CH<sub>4</sub> and N<sub>2</sub>O mass emissions under this subpart by following the applicable method specified in § 98.33(c).
- (b) Calculate and report biogenic CO<sub>2</sub> emissions under this subpart by following the applicable methods specified in § 98.33(e). The CO<sub>2</sub> emissions (excluding biogenic CO<sub>2</sub>) for units subject to this subpart that are reported under §§ 98.3(c)(4)(i) and (c)(4)(iii)(B) shall be calculated by subtracting the biogenic CO<sub>2</sub> mass emissions calculated according to § 98.33(e) from the cumulative annual CO<sub>2</sub> mass emissions from paragraph (a)(1) of this section. Separate calculation and reporting of biogenic CO<sub>2</sub> emissions is optional only for the 2010 reporting year pursuant to § 98.3(c)(12) and required every year thereafter.

[75 FR 79155, Dec. 17, 2010]

## § 98.44 Monitoring and QA/QC requirements.

Follow the applicable quality assurance procedures for CO<sub>2</sub> emissions in appendices B, D, and G to 40 CFR part 75.

## § 98.45 Procedures for estimating missing data.

Follow the applicable missing data substitution procedures in 40 CFR part 75 for CO<sub>2</sub> concentration, stack gas flow rate, fuel flow rate, high heating value, and fuel carbon content.

## § 98.46 Data reporting requirements.

The annual report shall comply with the data reporting requirements specified in § 98.36(d)(1).

[75 FR 79155, Dec. 17, 2010]

## § 98.47 Records that must be retained.

You shall comply with the recordkeeping requirements of §§ 98.3(g) and 98.37. Records retained under § 75.57(h) of this chapter for missing data events satisfy the recordkeeping requirements of § 98.3(g)(4) for those same events.

[75 FR 79155, Dec. 17, 2010]

## § 98.48 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart E—Adipic Acid Production

### § 98.50 Definition of source category.

The adipic acid production source category consists of all adipic acid production facilities that use oxidation to produce adipic acid.

### § 98.51 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an adipic acid production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.52 GHGs to report.

- (a) You must report N<sub>2</sub>O process emissions at the facility level.
- (b) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit following the requirements of subpart C.

### § 98.53 Calculating GHG emissions.

- (a) You must determine annual N<sub>2</sub>O emissions from adipic acid production according to paragraphs (a)(1) or (2) of this section.
  - (1) Use a site-specific emission factor and production data according to paragraphs (b) through (i) of this section.
  - (2) Request Administrator approval for an alternative method of determining N<sub>2</sub>O emissions according to paragraphs (a)(2)(i) through (iv) of this section.
    - (i) If you received Administrator approval for an alternative method of determining N<sub>2</sub>O emissions in the previous reporting year and your methodology is unchanged, your alternative method is automatically approved for the next reporting year.
    - (ii) You must notify the EPA of your use of a previously approved alternative method in your annual report.
    - (iii) Otherwise, you must submit the request within 45 days following promulgation of this subpart or within the first 30 days of each subsequent reporting year.

- (iv) If the Administrator does not approve your requested alternative method within 150 days of the end of the reporting year, you must determine the N<sub>2</sub>O emissions for the current reporting period using the procedures specified in paragraph (a)(1) of this section.
- (b) You must conduct an annual performance test according to paragraphs (b)(1) through (3) of this section.
  - (1) You must conduct the test on the vent stream from the nitric acid oxidation step of the process, referred to as the test point, according to the methods specified in § 98.54(b) through (f). If multiple adipic acid production units exhaust to a common abatement technology and/or emission point, you must sample each process in the ducts before the emissions are combined, sample each process when only one process is operating, or sample the combined emissions when multiple processes are operating and base the site-specific emission factor on the combined production rate of the multiple adipic acid production units.
  - (2) You must conduct the performance test under normal process operating conditions.
  - (3) You must measure the adipic acid production rate during the test and calculate the production rate for the test period in tons per hour.
- (c) Using the results of the performance test in paragraph (b) of this section, you must calculate an emission factor for each adipic acid unit according to Equation E-1 of this section:

$$EF_{N_2O,z} = \frac{\sum_{i=1}^n \frac{C_{N_2O} \cdot 1.14 \times 10^{-7} \cdot Q}{P}}{n} \quad (\text{Eq. E-1})$$

where:

$EF_{N_2O,z}$  = Average facility-specific N<sub>2</sub>O emission factor for each adipic acid production unit “z” (lb N<sub>2</sub>O/ton adipic acid produced).

$C_{N_2O}$  = N<sub>2</sub>O concentration per test run during the performance test (ppm N<sub>2</sub>O).

$1.14 \times 10^{-7}$  = Conversion factor (lb/dscf-ppm N<sub>2</sub>O).

Q = Volumetric flow rate of effluent gas per test run during the performance test (dscf/hr).

P = Production rate per test run during the performance test (tons adipic acid produced/hr).

n = Number of test runs.

- (d) If the adipic acid production unit exhausts to any N<sub>2</sub>O abatement technology “N”, you must determine the destruction efficiency according to paragraphs (d)(1), (d)(2), or (d)(3) of this section.
  - (1) Use the manufacturer's specified destruction efficiency.

- (2) Estimate the destruction efficiency through process knowledge. Examples of information that could constitute process knowledge include calculations based on material balances, process stoichiometry, or previous test results provided the results are still relevant to the current vent stream conditions. You must document how process knowledge was used to determine the destruction efficiency.
- (3) Calculate the destruction efficiency by conducting an additional performance test on the vent stream following the N<sub>2</sub>O abatement technology.
- (e) If the adipic acid production unit exhausts to any N<sub>2</sub>O abatement technology "N", you must determine the annual amount of adipic acid produced while N<sub>2</sub>O abatement technology "N" is operating according to § 98.54(f). Then you must calculate the abatement factor for N<sub>2</sub>O abatement technology "N" according to Equation E-2 of this section.

$$AF_N = \frac{P_{z,N}}{P_z} \quad (\text{Eq. E-2})$$

- (f) You must determine the annual amount of adipic acid produced according to § 98.54(f).
- (g) You must calculate N<sub>2</sub>O emissions according to paragraph (g)(1), (2), (3), or (4) of this section for each adipic acid production unit.
  - (1) If one N<sub>2</sub>O abatement technology "N" is located after your test point, you must use the emissions factor (determined in Equation E-1 of this section), the destruction efficiency (determined in paragraph (d) of this section), the annual adipic acid production (determined in paragraph (f) of this section), and the abatement utilization factor (determined in paragraph (e) of this section), according to Equation E-3a of this section:

$$E_{a,z} = \frac{EF_{N_2O,z} \cdot P_z}{2205} \cdot (1 - (DF + AF)) \quad (\text{Eq. E-3a})$$

where:

$E_{a,z}$  = Annual N<sub>2</sub>O mass emissions from adipic acid production unit "z" according to this Equation E-3a (metric tons).

$EF_{N_2O,z}$  = N<sub>2</sub>O emissions factor for unit "z" (lb N<sub>2</sub>O/ton adipic acid produced).

$P_z$  = Annual adipic acid produced from unit "z" (tons).

DF = Destruction efficiency of N<sub>2</sub>O abatement technology "N" (decimal fraction of N<sub>2</sub>O removed from vent stream).

AF = Abatement utilization factor of N<sub>2</sub>O abatement technology "N" (decimal fraction of time that the abatement technology is operating).

2205 = Conversion factor (lb/metric ton).

- (2) If multiple N<sub>2</sub>O abatement technologies are located in series after your test point, you must use the emissions factor (determined in Equation E-1 of this section), the destruction efficiency (determined in paragraph (d) of this section), the annual adipic acid production (determined in paragraph (f) of this section), and the abatement utilization factor (determined in paragraph (e) of this section), according to Equation E-3b of this section:

$$E_{b,z} = \frac{EF_{N_2O,z} \cdot P_z}{2205} \cdot [1 - (DF_1 \cdot AF_1)] \cdot [1 - (DF_2 \cdot AF_2)] \cdot \dots \cdot [1 - (DF_N \cdot AF_N)] \quad (\text{Eq. E-3b})$$

where:

$E_{b,z}$  = Annual N<sub>2</sub>O mass emissions from adipic acid production unit “z” according to this Equation E-3b (metric tons).

$EF_{N_2O,z}$  = N<sub>2</sub>O emissions factor for unit “z” (lb N<sub>2</sub>O/ton adipic acid produced).

$P_z$  = Annual adipic acid produced from unit “z” (tons).

$DF_1$  = Destruction efficiency of N<sub>2</sub>O abatement technology 1 (decimal fraction of N<sub>2</sub>O removed from vent stream).

$AF_1$  = Abatement utilization factor of N<sub>2</sub>O abatement technology 1 (decimal fraction of time that abatement technology 1 is operating).

$DF_2$  = Destruction efficiency of N<sub>2</sub>O abatement technology 2 (decimal fraction of N<sub>2</sub>O removed from vent stream).

$AF_2$  = Abatement utilization factor of N<sub>2</sub>O abatement technology 2 (decimal fraction of time that abatement technology 2 is operating).

$DF_N$  = Destruction efficiency of N<sub>2</sub>O abatement technology “N” (decimal fraction of N<sub>2</sub>O removed from vent stream).

$AF_N$  = Abatement utilization factor of N<sub>2</sub>O abatement technology “N” (decimal fraction of time that abatement technology N is operating).

2205 = Conversion factor (lb/metric ton).

N = Number of different N<sub>2</sub>O abatement technologies.

- (3) If multiple N<sub>2</sub>O abatement technologies are located in parallel after your test point, you must use the emissions factor (determined in Equation E-1 of this section), the destruction efficiency (determined in paragraph (d) of this section), the annual adipic acid production (determined in paragraph (f) of this section), and the abatement utilization factor (determined in paragraph (e) of this section), according to Equation E-3c of this section:



$$E_{c,z} = \frac{EF_{N_2O,z} \cdot P_z}{2205} \cdot \sum_1^N \left( (1 - (DF_N \cdot AF_N)) \cdot FC_N \right) \quad (\text{Eq. E-3c})$$

where:

$E_{c,z}$  = Annual  $N_2O$  mass emissions from adipic acid production unit "z" according to this Equation E-3c (metric tons).

$EF_{N_2O,z}$  =  $N_2O$  emissions factor for unit "z" (lb  $N_2O$ /ton adipic acid produced).

$P_z$  = Annual adipic acid produced from unit "z" (tons).

$DF_N$  = Destruction efficiency of  $N_2O$  abatement technology "N" (decimal fraction of  $N_2O$  removed from vent stream).

$AF_N$  = Abatement utilization factor of  $N_2O$  abatement technology "N" (decimal fraction of time that the abatement technology is operating).

$FC_N$  = Fraction control factor of  $N_2O$  abatement technology "N" (decimal fraction of total emissions from unit "z" that are sent to abatement technology "N").

2205 = Conversion factor (lb/metric ton).

N = Number of different  $N_2O$  abatement technologies with a fraction control factor.

- (4) If no  $N_2O$  abatement technologies are located after your test point, you must use the emissions factor (determined using Equation E-1 of this section) and the annual adipic acid production (determined in paragraph (f) of this section) according to Equation E-3d of this section for each adipic acid production unit.

$$E_{d,z} = \frac{EF_{N_2O,z} \cdot P_z}{2205} \quad (\text{Eq. E-3d})$$

where:

$E_{d,z}$  = Annual  $N_2O$  mass emissions from adipic acid production for unit "z" according to this Equation E-3d (metric tons).

$EF_{N_2O}$  =  $N_2O$  emissions factor for unit "z" (lb  $N_2O$ /ton adipic acid produced).

$P_z$  = Annual adipic acid produced from unit "z" (tons).

2205 = Conversion factor (lb/metric ton).

- (h) You must determine the emissions for the facility by summing the unit level emissions according to Equation E-4 of this section.

$$N_2O = \sum_{k=1}^M E_{a,k} + E_{b,k} + E_{c,k} + E_{d,k} \quad (\text{Eq. E-4})$$

where:

$E_{a,z}$  = Annual  $N_2O$  mass emissions from adipic acid production unit “z” according to Equation E-3a of this section (metric tons).

$E_{b,z}$  = Annual  $N_2O$  mass emissions from adipic acid production unit “z” according to Equation E-3b of this section (metric tons).

$E_{c,z}$  = Annual  $N_2O$  mass emissions from adipic acid production unit “z” according to Equation E-3c of this section (metric tons).

$E_{d,z}$  = Annual  $N_2O$  mass emissions from adipic acid production unit “z” according to Equation E-3d of this section (metric tons).

M = Total number of adipic acid production units.

- (i) You must determine the amount of process  $N_2O$  emissions that is sold or transferred off site (if applicable). You can determine the amount using existing process flow meters and  $N_2O$  analyzers.

[75 FR 66458, Oct. 28, 2010, as amended at 78 FR 71952, Nov. 29, 2013; 81 FR 89252, Dec. 9, 2016]

## § 98.54 Monitoring and QA/QC requirements.

- (a) You must conduct a new performance test and calculate a new emissions factor for each adipic acid production unit according to the frequency specified in paragraphs (a)(1) through (3) of this section.
- (1) Conduct the performance test annually. The test must be conducted at a point during production that is representative of the average emissions rate from your process. You must document the methods used to determine the representative point.
  - (2) Conduct the performance test when your adipic acid production process is changed either by altering the ratio of cyclohexanone to cyclohexanol or by installing abatement equipment.
  - (3) If you requested Administrator approval for an alternative method of determining  $N_2O$  emissions under § 98.53(a)(2), you must conduct the performance test if your request has not been approved by the Administrator within 150 days of the end of the reporting year in which it was submitted.
- (b) You must measure the  $N_2O$  concentration during the performance test using one of the methods in paragraphs (b)(1) through (b)(3) of this section.
- (1) EPA Method 320, Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy in 40 CFR part 63, Appendix A;
  - (2) ASTM D6348-03 Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy (incorporated by reference, see § 98.7); or

- (3) An equivalent method, with Administrator approval.
- (c) You must determine the adipic acid production rate during the performance test according to paragraph (c)(1) or (c)(2) of this section.
  - (1) Direct measurement (such as using flow meters or weigh scales).
  - (2) Existing plant procedures used for accounting purposes.
- (d) You must determine the volumetric flow rate during the performance test in conjunction with the applicable EPA methods in 40 CFR part 60, appendices A-1 through A-4. Conduct three emissions test runs of 1 hour each. All QA/QC procedures specified in the reference test methods and any associated performance specifications apply. For each test, the facility must prepare an emissions factor determination report that must include the items in paragraphs (d)(1) through (d)(3) of this section:
  - (1) Analysis of samples, determination of emissions, and raw data.
  - (2) All information and data used to derive the emissions factor.
  - (3) The production rate(s) during the performance test and how each production rate was determined.
- (e) You must determine the monthly amount of adipic acid produced. You must also determine the monthly amount of adipic acid produced during which N<sub>2</sub>O abatement technology is operating. These monthly amounts are determined according to the methods in paragraphs (c)(1) or (c)(2) of this section.
- (f) You must determine the annual amount of adipic acid produced. You must also determine the annual amount of adipic acid produced during which N<sub>2</sub>O abatement technology is operating. These are determined by summing the respective monthly adipic acid production quantities determined in paragraph (e) of this section.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66460, Oct. 28, 2010; 78 FR 71953, Nov. 29, 2013]

### § 98.55 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in paragraphs (a) and (b) of this section.

- (a) For each missing value of monthly adipic acid production, the substitute data shall be the best available estimate based on all available process data or data used for accounting purposes (such as sales records).
- (b) For missing values related to the performance test, including emission factors, production rate, and N<sub>2</sub>O concentration, you must conduct a new performance test according to the procedures in § 98.54 (a) through (d).

### § 98.56 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (n) of this section at the facility level.

- (a) Annual process N<sub>2</sub>O emissions from adipic acid production (metric tons).
- (b)-(c) [Reserved]

- (d) Annual process N<sub>2</sub>O emissions from adipic acid production facility that is sold or transferred off site (metric tons).
- (e) Number of abatement technologies (if applicable).
- (f) Types of abatement technologies used and date of installation for each (if applicable).
- (g) Abatement technology destruction efficiency for each abatement technology (percent destruction).
- (h) Abatement utilization factor for each abatement technology (fraction of annual production that abatement technology is operating).
- (i) Number of times in the reporting year that missing data procedures were followed to measure adipic acid production (months).
- (j) If you conducted a performance test and calculated a site-specific emissions factor according to § 98.53(a)(1), each annual report must also contain the information specified in paragraphs (j)(1) through (7) of this section for each adipic acid production unit.
  - (1) [Reserved]
  - (2) Test method used for performance test.
  - (3) [Reserved]
  - (4) N<sub>2</sub>O concentration per test run during performance test (ppm N<sub>2</sub>O).
  - (5) Volumetric flow rate per test run during performance test (dscf/hr).
  - (6) Number of test runs.
  - (7) Number of times in the reporting year that a performance test had to be repeated (number).
- (k) If you requested Administrator approval for an alternative method of determining N<sub>2</sub>O emissions under § 98.53(a)(2), each annual report must also contain the information specified in paragraphs (k)(1) through (4) of this section for each adipic acid production facility.
  - (1) Name of alternative method.
  - (2) Description of alternative method.
  - (3) Request date.
  - (4) Approval date.
- (l) Fraction control factor for each abatement technology (percent of total emissions from the production unit that are sent to the abatement technology) if equation E-3c is used.
- (m) If only cyclohexane is oxidized to produce adipic acid and the quantity is known, report the information specified in paragraph (m)(1) of this section. If materials other than cyclohexane are oxidized to produce adipic acid, report the information specified in paragraph (m)(2) of this section.
  - (1) Annual quantity of cyclohexane (tons) used to produce adipic acid.
  - (2) Annual quantity of cyclohexanone and cyclohexanol mixture (tons) used to produce adipic acid.
- (n) Annual percent N<sub>2</sub>O emission reduction for all production units combined.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66460, Oct. 28, 2010; 79 FR 63784, Oct. 24, 2014; 81 FR 89253, Dec. 9, 2016]

## § 98.57 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the records specified in paragraphs (a) through (i) of this section at the facility level:

- (a) Annual adipic acid production capacity (tons).
- (b) Records of significant changes to process.
- (c) Number of facility and unit operating hours in calendar year.
- (d) Documentation of how accounting procedures were used to estimate production rate.
- (e) Documentation of how process knowledge was used to estimate abatement technology destruction efficiency.
- (f) Performance test reports.
- (g) Measurements, records and calculations used to determine reported parameters.
- (h) Documentation of the procedures used to ensure the accuracy of the measurements of all reported parameters, including but not limited to, calibration of weighing equipment, flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (i) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (i)(1) through (3) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (i)(1) through (3) of this section.
  - (1) Annual adipic acid production from each adipic acid production unit (tons) (Equations E-2, E-3a, E-3b, E-3c, and E-3d of § 98.53).
  - (2) Production rate per test run during the performance test for each production unit test run (tons adipic acid produced/hr) (Equation E-1 of § 98.53).
  - (3) Annual adipic acid production per N<sub>2</sub>O abatement technology during which N<sub>2</sub>O abatement technology was used (tons adipic acid produced) (Equation E-2).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66461, Oct. 28, 2010; 79 FR 63784, Oct. 24, 2014]

## § 98.58 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart F—Aluminum Production

### § 98.60 Definition of the source category.

- (a) A primary aluminum production facility manufactures primary aluminum using the Hall-Héroult manufacturing process. The primary aluminum manufacturing process comprises the following operations:
  - (1) Electrolysis in prebake and Söderberg cells.

(2) Anode baking for prebake cells.

(b) This source category does not include experimental cells or research and development process units.

### § 98.61 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an aluminum production process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.62 GHGs to report.

You must report:

- (a) Perfluoromethane (CF<sub>4</sub>), and perfluoroethane (C<sub>2</sub>F<sub>6</sub>) emissions from anode effects in all prebake and Söderberg electrolysis cells.
- (b) CO<sub>2</sub> emissions from anode consumption during electrolysis in all prebake and Söderberg electrolysis cells.
- (c) CO<sub>2</sub> emissions from on-site anode baking.
- (d) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub> emissions from each stationary fuel combustion unit by following the requirements of subpart C.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79155, Dec. 17, 2010]

### § 98.63 Calculating GHG emissions.

- (a) The annual value of each PFC compound (CF<sub>4</sub>, C<sub>2</sub>F<sub>6</sub>) shall be estimated from the sum of monthly values using Equation F-1 of this section:

$$E_{PFC} = \sum_{m=1}^{m=12} E_m \quad (\text{Eq. F-1})$$

Where:

$E_{PFC}$  = Annual emissions of each PFC compound from aluminum production (metric tons PFC).

$E_m$  = Emissions of the individual PFC compound from aluminum production for the month “m” (metric tons PFC).

- (b) Use Equation F-2 of this section to estimate CF<sub>4</sub> emissions from anode effect duration or Equation F-3 of this section to estimate CF<sub>4</sub> emissions from overvoltage, and use Equation F-4 of this section to estimate C<sub>2</sub>F<sub>6</sub> emissions from anode effects from each prebake and Söderberg electrolysis cell.

$$E_{CF_4} = S_{CF_4} \times AEM \times MP \times 0.001 \quad (\text{Eq. F-2})$$

Where:

$E_{CF_4}$  = Monthly CF<sub>4</sub> emissions from aluminum production (metric tons CF<sub>4</sub>).

$S_{CF_4}$  = The slope coefficient ((kg CF<sub>4</sub>/metric ton Al)/(AE-Mins/cell-day)).

AEM = The anode effect minutes per cell-day (AE-Mins/cell-day).

MP = Metal production (metric tons Al), where AEM and MP are calculated monthly.

$$E_{CF_4} = EF_{CF_4} \times MP \times 0.001 \quad (\text{Eq. F-3})$$

Where:

$E_{CF_4}$  = Monthly CF<sub>4</sub> emissions from aluminum production (metric tons CF<sub>4</sub>).

$EF_{CF_4}$  = The overvoltage emission factor (kg CF<sub>4</sub>/metric ton Al).

MP = Metal production (metric tons Al), where MP is calculated monthly.

$$E_{C_2F_6} = E_{CF_4} \times F_{C_2F_6/CF_4} \times 0.001 \quad (\text{Eq. F-4})$$

Where:

$E_{C_2F_6}$  = Monthly C<sub>2</sub>F<sub>6</sub> emissions from aluminum production (metric tons C<sub>2</sub>F<sub>6</sub>).

$E_{CF_4}$  = CF<sub>4</sub> emissions from aluminum production (kg CF<sub>4</sub>).

$F_{C_2F_6/CF_4}$  = The weight fraction of C<sub>2</sub>F<sub>6</sub>/CF<sub>4</sub> (kg C<sub>2</sub>F<sub>6</sub>/kg CF<sub>4</sub>).

0.001 = Conversion factor from kg to metric tons, where  $E_{CF_4}$  is calculated monthly.

- (c) You must calculate and report the annual process CO<sub>2</sub> emissions from anode consumption during electrolysis and anode baking of prebake cells using either the procedures in paragraph (d) of this section, the procedures in paragraphs (e) and (f) of this section, or the procedures in paragraph (g) of this section.
- (d) Calculate and report under this subpart the process CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (e) Use the following procedures to calculate CO<sub>2</sub> emissions from anode consumption during electrolysis:
  - (1) For Prebake cells: you must calculate CO<sub>2</sub> emissions from anode consumption using Equation F-5 of this section:

$$E_{CO_2} = NAC \times MP \times [(100 - S_a - Ash_a)/100] \times (44/12) \quad (\text{Eq. F-5})$$

Where:

$E_{CO_2}$  = Annual CO<sub>2</sub> emissions from prebaked anode consumption (metric tons CO<sub>2</sub>).

NAC = Net annual prebaked anode consumption per metric ton Al (metric tons C/metric tons Al).

MP = Annual metal production (metric tons Al).

S<sub>a</sub> = Sulfur content in baked anode (percent weight).

Ash<sub>a</sub> = Ash content in baked anode (percent weight).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

(2) For Söderberg cells you must calculate CO<sub>2</sub> emissions using Equation F-6 of this section:

$$E_{CO_2} = (PC \times MP - |CSM \times MP|/1000 - BC/100 \times PC \times MP \times [S_p + Ash_p + H_p]/100 - |100 - BC|/100 \times PC \times MP \times [S_c + Ash_c]/100 - MP \times CD) \times (44/12) \quad (Eq. F-6)$$

Where:

E<sub>CO2</sub> = Annual CO<sub>2</sub> emissions from paste consumption (metric ton CO<sub>2</sub>).

PC = Annual paste consumption (metric ton/metric ton Al).

MP = Annual metal production (metric ton Al).

CSM = Annual emissions of cyclohexane soluble matter (kg/metric ton Al).

BC = Binder content of paste (percent weight).

S<sub>p</sub> = Sulfur content of pitch (percent weight).

Ash<sub>p</sub> = Ash content of pitch (percent weight).

H<sub>p</sub> = Hydrogen content of pitch (percent weight).

S<sub>c</sub> = Sulfur content in calcined coke (percent weight).

Ash<sub>c</sub> = Ash content in calcined coke (percent weight).

CD = Carbon in skimmed dust from Söderberg cells (metric ton C/metric ton Al).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

(f) Use the following procedures to calculate CO<sub>2</sub> emissions from anode baking of prebake cells:

(1) Use Equation F-7 of this section to calculate emissions from pitch volatiles combustion.

$$E_{CO_2PV} = (GA - H_w - BA - WT) \times (44/12) \quad (Eq. F-7)$$



Where:

$E_{CO_2PV}$  = Annual CO<sub>2</sub> emissions from pitch volatiles combustion (metric tons CO<sub>2</sub>).

GA = Initial weight of green anodes (metric tons).

$H_w$  = Annual hydrogen content in green anodes (metric tons).

BA = Annual baked anode production (metric tons).

WT = Annual waste tar collected (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

(2) Use Equation F-8 of this section to calculate emissions from bake furnace packing material.

$$E_{CO_2PC} = PCC \times BA \times \left[ \left( 100 - S_{pc} - Ash_{pc} \right) / 100 \right] \times (44/12) \quad (\text{Eq. F-8})$$

Where:

$E_{CO_2PC}$  = Annual CO<sub>2</sub> emissions from bake furnace packing material (metric tons CO<sub>2</sub>).

PCC = Annual packing coke consumption (metric tons/metric ton baked anode).

BA = Annual baked anode production (metric tons).

$S_{pc}$  = Sulfur content in packing coke (percent weight).

$Ash_{pc}$  = Ash content in packing coke (percent weight).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

- (g) If process CO<sub>2</sub> emissions from anode consumption during electrolysis or anode baking of prebake cells are vented through the same stack as any combustion unit or process equipment that reports CO<sub>2</sub> emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraphs (d) and (e) of this section shall not be used to calculate those process emissions. The owner or operation shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79155, Dec. 17, 2010]

## § 98.64 Monitoring and QA/QC requirements.

- (a) Effective December 31, 2010 for smelters with no prior measurement or effective December 31, 2012, for facilities with historic measurements, the smelter-specific slope coefficients, overvoltage emission factors, and weight fractions used in Equations F-2, F-3, and F-4 of this subpart must be measured in accordance with the recommendations of the EPA/IAI Protocol for Measurement of Tetrafluoromethane (CF<sub>4</sub>) and Hexafluoroethane (C<sub>2</sub>F<sub>6</sub>) Emissions from Primary Aluminum Production (2008) (incorporated by reference, see § 98.7), except the minimum frequency of measurement shall be every 10 years unless a change occurs in the control algorithm that affects the mix of types of anode effects or the nature of the anode effect termination routine. Facilities which operate at less than 0.2 anode effect minutes per cell day or operate with less than 1.4mV anode effect overvoltage can use either smelter-specific slope coefficients or the technology specific default values in Table F-1 of this subpart.
- (b) The minimum frequency of the measurement and analysis is annually except as follows:
  - (1) Monthly for anode effect minutes per cell day (or anode effect overvoltage and current efficiency).
  - (2) Monthly for aluminum production.
  - (3) Smelter-specific slope coefficients, overvoltage emission factors, and weight fractions according to paragraph (a) of this section.
- (c) Sources may use either smelter-specific values from annual measurements of parameters needed to complete the equations in § 98.63 (e.g., sulfur, ash, and hydrogen contents) or the default values shown in Table F-2 of this subpart.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79155, Dec. 17, 2010]

## § 98.65 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required sample measurement is not taken), a substitute data value for the missing parameter shall be used in the calculations, according to the following requirements:

- (a) Where anode or paste consumption data are missing, CO<sub>2</sub> emissions can be estimated from aluminum production by using Equation F-9 of this section.

$$ECO_2 = EF_p \times MP_p + EF_s \times MP_s \quad (\text{Eq. F-9})$$

Where:

ECO<sub>2</sub> = CO<sub>2</sub> emissions from anode and/or paste consumption, metric tons CO<sub>2</sub>.

EF<sub>p</sub> = Prebake technology specific emission factor (1.6 metric tons CO<sub>2</sub>/metric ton aluminum produced).

MP<sub>p</sub> = Metal production from prebake process (metric tons Al).

EF<sub>s</sub> = Søderberg technology specific emission factor (1.7 metric tons CO<sub>2</sub>/metric ton Al produced).

MP<sub>s</sub> = Metal production from Söderberg process (metric tons Al).

- (b) For other parameters, use the average of the two most recent data points after the missing data.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79156, Dec. 17, 2010; 81 FR 89253, Dec. 9, 2016]

## § 98.66 Data reporting requirements.

In addition to the information required by § 98.3(c), you must report the following information at the facility level:

- (a) [Reserved]
- (b) Type of smelter technology used.
- (c) The following PFC-specific information on an annual basis:
  - (1) Perfluoromethane emissions and perfluoroethane emissions from anode effects in all prebake and all Söderberg electrolysis cells combined.
  - (2) Anode effect minutes per cell-day (AE-mins/cell-day), anode effect frequency (AE/cell-day), anode effect duration (minutes). (Or anode effect overvoltage factor ((kg CF<sub>4</sub>/metric ton Al)/(mV/cell day)), potline overvoltage (mV/cell day), current efficiency (%)).
  - (3) Smelter-specific slope coefficients (or overvoltage emission factors) and the last date when the smelter-specific slope coefficients (or overvoltage emission factors) were measured.
- (d) Method used to measure the frequency and duration of anode effects (or overvoltage).
- (e) The following CO<sub>2</sub>-specific information for prebake cells:
  - (1) Annual anode consumption if using the method in § 98.63(g).
  - (2) Annual CO<sub>2</sub> emissions from the smelter.
- (f) The following CO<sub>2</sub>-specific information for Söderberg cells:
  - (1) Annual paste consumption if using the method in § 98.63(g).
  - (2) Annual CO<sub>2</sub> emissions from the smelter.
- (g) [Reserved]
- (h) Exact data elements required will vary depending on smelter technology (e.g., point-feed prebake or Söderberg) and process control technology (e.g., Pechiney or other).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79156, Dec. 17, 2010; 79 FR 63784, Oct. 24, 2014; 81 FR 89253, Dec. 9, 2016]

## § 98.67 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the following records:

- (a) Monthly aluminum production in metric tons.
- (b) Type of smelter technology used.
- (c) The following PFC-specific information on a monthly basis:

- (1) Perfluoromethane and perfluoroethane emissions from anode effects in prebake and Søderberg electrolysis cells.
  - (2) Anode effect minutes per cell-day (AE-mins/cell-day), anode effect frequency (AE/cell-day), anode effect duration (minutes). (Or anode effect overvoltage factor ((kg CF<sub>4</sub>/metric ton Al)/(mV/cell day)), potline overvoltage (mV/cell day), current efficiency (%).))
  - (3) Smelter-specific slope coefficients and the last date when the smelter-specific-slope coefficients were measured.
- (d) Method used to measure the frequency and duration of anode effects (or to measure anode effect overvoltage and current efficiency).
- (e) The following CO<sub>2</sub>-specific information for prebake cells:
- (1) Annual anode consumption.
  - (2) Annual CO<sub>2</sub> emissions from the smelter.
- (f) The following CO<sub>2</sub>-specific information for Søderberg cells:
- (1) Annual paste consumption.
  - (2) Annual CO<sub>2</sub> emissions from the smelter.
- (g) Smelter-specific inputs to the CO<sub>2</sub> process equations (e.g., levels of sulfur and ash) that were used in the calculation, on an annual basis.
- (h) Exact data elements required will vary depending on smelter technology (e.g., point-feed prebake or Søderberg) and process control technology (e.g., Pechiney or other).
- (i) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (i)(1) through (30) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (i)(1) through (30) of this section.
- (1) Slope coefficient per potline per month (kg CF<sub>4</sub>/metric ton Al)/(AE-Mins/cell-day)) (Equation F-2 of § 98.63).
  - (2) Anode effect minutes per cell-day per potline per month (AE-Mins/cell-day) (Equation F-2).
  - (3) Anode effect frequency per potline per month (AE/cell-day) (Equation F-2).
  - (4) Anode effect duration per potline per month (minutes) (Equation F-2).
  - (5) Metal production of aluminum per potline per month (metric tons) (Equation F-2).
  - (6) Overvoltage emission factor per potline per month (kg CF<sub>4</sub>/metric ton Al) (Equation F-3 of § 98.63).
  - (7) Metal production of aluminum per potline per month (metric tons) (Equation F-3).
  - (8) Weight fraction of C<sub>2</sub>F<sub>6</sub>/CF<sub>4</sub> per potline per month (kg C<sub>2</sub>F<sub>6</sub>/kg CF<sub>4</sub>) (Equation F-4 of § 98.63).
  - (9) Net annual prebaked anode consumption (metric tons C/metric tons Al) (Equation F-5 of § 98.63).
  - (10) Annual metal production of aluminum (metric tons) (Equation F-5).
  - (11) Sulfur content in baked anode (weight percent) (Equation F-5).

- (12) Ash content in baked anode (weight percent) (Equation F-5).
- (13) Annual paste consumption (metric ton/metric ton Al) (Equation F-6 of § 98.63).
- (14) Annual metal production of aluminum (metric tons) (Equation F-6).
- (15) Annual emissions of cyclohexane soluble matter (kg/metric ton Al) (Equation F-6).
- (16) Binder content of paste (weight percent) (Equation F-6).
- (17) Sulfur content of pitch (weight percent) (Equation F-6).
- (18) Ash content of pitch (weight percent) (Equation F-6).
- (19) Hydrogen content of pitch (weight percent) (Equation F-6).
- (20) Sulfur content in calcined coke (weight percent) (Equation F-6).
- (21) Ash content in calcined coke (weight percent) (Equation F-6).
- (22) Carbon in skimmed dust from Søderberg cells (metric ton C/metric ton Al) (Equation F-6).
- (23) Initial weight of green anodes (metric tons) (Equation F-7 of § 98.63).
- (24) Annual hydrogen content in green anodes (metric tons) (Equation F-7).
- (25) Annual baked anode production (metric tons) (Equation F-7).
- (26) Annual waste tar collected (metric tons) (Equation F-7).
- (27) Annual packing coke consumption (metric tons/metric ton baked anode) (Equation F-8 of § 98.63).
- (28) Annual baked anode production (metric tons) (Equation F-8).
- (29) Sulfur content in packing coke (weight percent) (Equation F-8).
- (30) Ash content in packing coke (weight percent) (Equation F-8).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63784, Oct. 24, 2014]

## § 98.68 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Table F-1 to Subpart F of Part 98—Slope and Overvoltage Coefficients for the Calculation of PFC Emissions From Aluminum Production**

| Technology                   | CF <sub>4</sub> slope coefficient<br>[(kg CF <sub>4</sub> /metric ton Al)/(AE-Mins/cell-day)] | CF <sub>4</sub> overvoltage coefficient<br>[(kg CF <sub>4</sub> /metric ton Al)/(mV)] | Weight fraction<br>C <sub>2</sub> F <sub>6</sub> /CF <sub>4</sub><br>[(kg C <sub>2</sub> F <sub>6</sub> /kg CF <sub>4</sub> )] |
|------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Center Worked Prebake (CWPB) | 0.143                                                                                         | 1.16                                                                                  | 0.121                                                                                                                          |

| Technology                      | CF <sub>4</sub> slope coefficient<br>[(kg CF <sub>4</sub> /metric ton Al)/(AE-Mins/cell-day)] | CF <sub>4</sub> overvoltage coefficient<br>[(kg CF <sub>4</sub> /metric ton Al)/(mV)] | Weight fraction C <sub>2</sub> F <sub>6</sub> /CF <sub>4</sub><br>[(kg C <sub>2</sub> F <sub>6</sub> /kg CF <sub>4</sub> )] |
|---------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Side Worked Prebake (SWPB)      | 0.272                                                                                         | 3.65                                                                                  | 0.252                                                                                                                       |
| Vertical Stud Söderberg (VSS)   | 0.092                                                                                         | NA                                                                                    | 0.053                                                                                                                       |
| Horizontal Stud Söderberg (HSS) | 0.099                                                                                         | NA                                                                                    | 0.085                                                                                                                       |

[75 FR 79156, Dec. 17, 2010]

**Table F-2 to Subpart F of Part 98—Default Data Sources for Parameters Used for CO<sub>2</sub> Emissions**

| Parameter                                                                                   | Data source                      |
|---------------------------------------------------------------------------------------------|----------------------------------|
| CO <sub>2</sub> Emissions from Prebake Cells (CWPB and SWPB)                                |                                  |
| MP: metal production (metric tons Al)                                                       | Individual facility records.     |
| NAC: net annual prebaked anode consumption per metric ton Al (metric tons C/metric tons Al) | Individual facility records.     |
| S <sub>a</sub> : sulfur content in baked anode (percent weight)                             | 2.0.                             |
| Ash <sub>a</sub> : ash content in baked anode (percent weight)                              | 0.4.                             |
| CO <sub>2</sub> Emissions From Pitch Volatiles Combustion (CWPB and SWPB)                   |                                  |
| MP: metal production (metric tons Al)                                                       | Individual facility records.     |
| PC: annual paste consumption (metric ton/metric ton Al)                                     | Individual facility records.     |
| CSM: annual emissions of cyclohexane soluble matter (kg/metric ton Al)                      | HSS: 4.0.<br>VSS: 0.5.           |
| BC: binder content of paste (percent weight)                                                | Dry Paste: 24.<br>Wet Paste: 27. |
| S <sub>p</sub> : sulfur content of pitch (percent weight)                                   | 0.6.                             |
| Ash <sub>p</sub> : ash content of pitch (percent weight)                                    | 0.2.                             |
| H <sub>p</sub> : hydrogen content of pitch (percent weight)                                 | 3.3.                             |
| S <sub>c</sub> : sulfur content in calcined coke (percent weight)                           | 1.9.                             |
| Ash <sub>c</sub> : ash content in calcined coke (percent weight)                            | 0.2.                             |
| CD: carbon in skimmed dust from Söderberg cells (metric ton C/metric ton Al)                | 0.01.                            |

| Parameter                                                                     | Data source                  |
|-------------------------------------------------------------------------------|------------------------------|
| CO <sub>2</sub> Emissions from Pitch Volatiles Combustion (VSS and HSS)       |                              |
| GA: initial weight of green anodes (metric tons)                              | Individual facility records. |
| H <sub>w</sub> : annual hydrogen content in green anodes (metric tons)        | 0.005 × GA.                  |
| BA: annual baked anode production (metric tons)                               | Individual facility records. |
| WT: annual waste tar collected (metric tons)                                  | (a) 0.005 × GA.              |
| (a) Riedhammer furnaces                                                       | (b) insignificant.           |
| (b) all other furnaces                                                        |                              |
| CO <sub>2</sub> Emissions From Bake Furnace Packing Materials (CWPB and SWPB) |                              |
| PCC: annual packing coke consumption (metric tons/metric ton baked anode)     | 0.015.                       |
| BA: annual baked anode production (metric tons)                               | Individual facility records. |
| S <sub>pc</sub> : sulfur content in packing coke (percent weight)             | 2.                           |
| Ash <sub>pc</sub> : ash content in packing coke (percent weight)              | 2.5.                         |

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79156, Dec. 17, 2010]

## Subpart G—Ammonia Manufacturing

### § 98.70 Definition of source category.

The ammonia manufacturing source category comprises the process units listed in paragraphs (a) and (b) of this section.

- (a) Ammonia manufacturing processes in which ammonia is manufactured from a fossil-based feedstock produced via steam reforming of a hydrocarbon.
- (b) Ammonia manufacturing processes in which ammonia is manufactured through the gasification of solid and liquid raw material.

### § 98.71 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an ammonia manufacturing process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.72 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from steam reforming of a hydrocarbon or the gasification of solid and liquid raw material, reported for each ammonia manufacturing unit following the requirements of this subpart.

- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary fuel combustion unit. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources), by following the requirements of subpart C, except that for ammonia manufacturing processes subpart C does not apply to any CO<sub>2</sub> resulting from combustion of the waste recycle stream (commonly referred to as the purge gas stream).
- (c) CO<sub>2</sub> emissions collected and transferred off site under subpart PP of this part (Suppliers of CO<sub>2</sub>), following the requirements of subpart PP.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79156, Dec. 17, 2010; 89 FR 31904, Apr. 25, 2024]

### § 98.73 Calculating GHG emissions.

You must calculate and report the annual CO<sub>2</sub> process emissions from each ammonia manufacturing unit using the procedures in either paragraph (a) or (b) of this section.

- (a) Calculate and report under this subpart the process CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart process CO<sub>2</sub> emissions using the procedures in paragraphs (b)(1) through (4) of this section, as applicable.
  - (1) **Gaseous feedstock.** You must calculate, from each ammonia manufacturing unit, the CO<sub>2</sub> process emissions from gaseous feedstock according to equation G-1 to this section:

$$CO_{2,G} = \left( \sum_{n=1}^{12} \frac{44}{12} * Fdstk_n * CC_n * \frac{MW}{MVC} \right) * 0.001 \quad (\text{Eq. G-1})$$

Where:

CO<sub>2,G</sub> = Annual CO<sub>2</sub> emissions arising from gaseous feedstock consumption (metric tons).

Fdstk<sub>n</sub> = Volume of the gaseous feedstock used in month n (scf of feedstock).

CC<sub>n</sub> = Carbon content of the gaseous feedstock, for month n (kg C per kg of feedstock), determined according to § 98.74(c).

MW = Molecular weight of the gaseous feedstock (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf per kg-mole at standard conditions).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.001 = Conversion factor from kg to metric tons.

n = Number of month.



- (2) **Liquid feedstock.** You must calculate, from each ammonia manufacturing unit, the CO<sub>2</sub> process emissions from liquid feedstock according to equation G-2 to this section:

$$CO_{2,L} = \left( \sum_{n=1}^{12} \frac{44}{12} * Fdstk_n * CC_n \right) * 0.001 \quad (\text{Eq. G-2})$$

Where:

CO<sub>2,L</sub> = Annual CO<sub>2</sub> emissions arising from liquid feedstock consumption (metric tons).

Fdstk<sub>n</sub> = Volume of the liquid feedstock used in month n (gallons of feedstock).

CC<sub>n</sub> = Carbon content of the liquid feedstock, for month n (kg C per gallon of feedstock) determined according to § 98.74(c).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.001 = Conversion factor from kg to metric tons.

n = Number of month.

- (3) **Solid feedstock.** You must calculate, from each ammonia manufacturing unit, the CO<sub>2</sub> process emissions from solid feedstock according to equation G-3 to this section:

$$CO_{2,S} = \left( \sum_{n=1}^{12} \frac{44}{12} * Fdstk_n * CC_n \right) * 0.001 \quad (\text{Eq. G-3})$$

Where:

CO<sub>2,S</sub> = Annual CO<sub>2</sub> emissions arising from solid feedstock consumption (metric tons).

Fdstk<sub>n</sub> = Mass of the solid feedstock used in month n (kg of feedstock).

CC<sub>n</sub> = Carbon content of the solid feedstock, for month n (kg C per kg of feedstock), determined according to § 98.74(c).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.001 = Conversion factor from kg to metric tons.

n = Number of month.

- (4) **CO<sub>2</sub> process emissions.** You must calculate the annual CO<sub>2</sub> process emissions at each ammonia manufacturing unit according to equation G-4 to this section:

$$CO_2 = \sum_{p=1}^3 CO_{2,p} \quad (\text{Eq. G-4})$$

Where:

$CO_2$  = Annual  $CO_2$  process emissions from each ammonia manufacturing unit (metric tons).

$CO_{2,p}$  = Annual  $CO_2$  process emissions arising from feedstock consumption based on feedstock type "p" (metric tons/yr) as calculated in paragraphs (b)(1) through (3) of this section.

p = Index for feedstock type; 1 indicates gaseous feedstock; 2 indicates liquid feedstock; and 3 indicates solid feedstock.

- (c) If GHG emissions from an ammonia manufacturing unit are vented through the same stack as any combustion unit or process equipment that reports  $CO_2$  emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate process emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79156, Dec. 17, 2010; 89 FR 31904, Apr. 25, 2024]

## § 98.74 Monitoring and QA/QC requirements.

- (a) You must continuously measure the quantity of gaseous or liquid feedstock consumed using a flow meter. The quantity of solid feedstock consumed can be obtained from company records and aggregated on a monthly basis.
- (b) You must document the procedures used to ensure the accuracy of the estimates of feedstock consumption.
- (c) You must determine monthly carbon contents and the average molecular weight of each feedstock consumed from reports from your supplier. As an alternative to using supplier information on carbon contents, you can also collect a sample of each feedstock on a monthly basis and analyze the carbon content and molecular weight of the fuel using any of the following methods listed in paragraphs (c)(1) through (c)(8) of this section, as applicable.
  - (1) ASTM D1945-03 Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (2) ASTM D1946-90 (Reapproved 2006) Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (3) ASTM D2502-04 (Reapproved 2002) Standard Test Method for Estimation of Mean Relative Molecular Mass of Petroleum Oils from Viscosity Measurements (incorporated by reference, see § 98.7).
  - (4) ASTM D2503-92 (Reapproved 2007) Standard Test Method for Relative Molecular Mass (Molecular Weight) of Hydrocarbons by Thermoelectric Measurement of Vapor Pressure (incorporated by reference, see § 98.7).
  - (5) ASTM D3238-95 (Reapproved 2005) Standard Test Method for Calculation of Carbon Distribution and Structural Group Analysis of Petroleum Oils by the n-d-M Method (incorporated by reference, see § 98.7).

- (6) ASTM D5291-02 (Reapproved 2007) Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants (incorporated by reference, see § 98.7).
- (7) ASTM D3176-89 (Reapproved 2002) Standard Practice for Ultimate Analysis of Coal and Coke (incorporated by reference, see § 98.7).
- (8) ASTM D5373-08 Standard Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7).
- (d) Calibrate all oil and gas flow meters that are used to measure liquid and gaseous feedstock volumes and flow rates (except for gas billing meters) according to the monitoring and QA/QC requirements for the Tier 3 methodology in § 98.34(b)(1). Perform oil tank drop measurements (if used to quantify feedstock volumes) according to § 98.34(b)(2).
- (e) For quality assurance and quality control of the supplier data, on an annual basis, you must measure the carbon contents of a representative sample of the feedstocks consumed using the appropriate ASTM Method as listed in paragraphs (c)(1) through (c)(8) of this section.
- (f) You may use company records or an engineering estimate to determine the annual ammonia production and the annual methanol production.
- (g) If CO<sub>2</sub> from ammonia production is used to produce urea at the same facility, you must determine the quantity of urea produced using methods or plant instruments used for accounting purposes (such as sales records). You must document the procedures used to ensure the accuracy of the estimates of urea produced.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79156, Dec. 17, 2010; 81 FR 89253, Dec. 9, 2016]

### § 98.75 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever the monitoring and quality assurance procedures in § 98.74 cannot be followed (e.g., if a meter malfunctions during unit operation), a substitute data value for the missing parameter shall be used in the calculations following paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) For missing data on monthly carbon contents of feedstock, the substitute data value shall be the arithmetic average of the quality-assured values of that carbon content in the month preceding and the month immediately following the missing data incident. If no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value for carbon content obtained in the month after the missing data period.
- (b) For missing feedstock supply rates used to determine monthly feedstock consumption, you must determine the best available estimate(s) of the parameter(s), based on all available process data.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79157, Dec. 17, 2010; 78 FR 71953, Nov. 29, 2013]

### § 98.76 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) and (b) of this section, as applicable for each ammonia manufacturing unit.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report the relevant information required under § 98.36 for the Tier 4 Calculation Methodology and the information in paragraphs (a)(1) through (3) of this section:
  - (1) Annual quantity of each type of feedstock consumed for ammonia manufacturing (scf of feedstock or gallons of feedstock or kg of feedstock).
  - (2) Method used for determining quantity of feedstock used.
  - (3) Annual ammonia production (metric tons, sum of all process units reported within subpart G of this part).
- (b) If a CEMS is not used to measure emissions, then you must report all of the following information in this paragraph (b):
  - (1) Annual CO<sub>2</sub> process emissions (metric tons) for each ammonia manufacturing unit.
  - (2) Annual quantity of each type of feedstock consumed for ammonia manufacturing (scf of feedstock or gallons of feedstock or kg of feedstock).
  - (3) Method used for determining quantity of monthly feedstock used.
  - (4) Whether carbon content for each feedstock for month n is based on reports from the supplier or analysis of carbon content.
  - (5) If carbon content of feedstock for month n is based on analysis, the test method used.
  - (6) Sampling analysis results of carbon content of feedstock as determined for QA/QC of supplier data under § 98.74(e).
  - (7) Annual average carbon content of each type of feedstock consumed.
  - (8)-(11) [Reserved]
  - (12) Annual urea production (metric tons) and method used to determine urea production.
  - (13) Annual amount of CO<sub>2</sub> (metric tons) collected from ammonia production and consumed on site for urea production and the method used to determine the CO<sub>2</sub> consumed in urea production.
  - (14) Annual ammonia production (metric tons, sum of all process units reported within subpart G).
  - (15) Annual quantity of methanol intentionally produced as a desired product, for each process unit (metric tons).
  - (16) Annual quantity of excess hydrogen produced that is not consumed through the production of ammonia (metric tons).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79157, Dec. 17, 2010; 78 FR 71953, Nov. 29, 2013; 79 FR 63785, Oct. 24, 2014; 81 FR 89253, Dec. 9, 2016; 89 FR 31904, Apr. 25, 2024]

## § 98.77 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the following records specified in paragraphs (a) through (c) of this section for each ammonia manufacturing unit.

- (a) If a CEMS is used to measure emissions, retain records of all feedstock purchases in addition to the requirements in § 98.37 for the Tier 4 Calculation Methodology.
- (b) If a CEMS is not used to measure process CO<sub>2</sub> emissions, you must also retain the records specified in paragraphs (b)(1) through (b)(2) of this section:
  - (1) Records of all analyses and calculations conducted for reported data as listed in § 98.76(b).
  - (2) Monthly records of carbon content of feedstock from supplier and/or all analyses conducted of carbon content.
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) through (7) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) through (7) of this section.
  - (1) Volume of each gaseous feedstock used in month (scf of feedstock) (in Equation G-1 of § 98.73).
  - (2) Carbon content of each gaseous feedstock, for month (kg C per kg of feedstock) (in Equation G-1).
  - (3) Molecular weight of each gaseous feedstock per ammonia manufacturing unit with gaseous feedstock (kg/kg-mole) (Equation G-1).
  - (4) Volume of each liquid feedstock used in month (gallons of feedstock) (Equation G-2 of § 98.73).
  - (5) Carbon content of each liquid feedstock, for month (kg C per gallon of feedstock) (Equation G-2).
  - (6) Mass of each solid feedstock used in month (kg of feedstock) (Equation G-3 of § 98.73).
  - (7) Carbon content of each solid feedstock, for month (kg C per kg of feedstock) (Equation G-3).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63785, Oct. 24, 2014]

## § 98.78 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart H—Cement Production

### § 98.80 Definition of the source category.

The cement production source category consists of each kiln and each in-line kiln/raw mill at any portland cement manufacturing facility including alkali bypasses, and includes kilns and in-line kiln/raw mills that burn hazardous waste.

### § 98.81 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a cement production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.82 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from calcination in each kiln.
- (b) CO<sub>2</sub> combustion emissions from each kiln.
- (c) CH<sub>4</sub> and N<sub>2</sub>O combustion emissions from each kiln. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (d) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit other than kilns. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

### § 98.83 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each kiln using the procedure in paragraphs (a) and (b) of this section.

- (a) For each cement kiln that meets the conditions specified in § 98.33(b)(4)(ii) or (b)(4)(iii), you must calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) For each kiln that is not subject to the requirements in paragraph (a) of this section, calculate and report the process and combustion CO<sub>2</sub> emissions from the kiln by using the procedure in either paragraph (c) or (d) of this section.
- (c) Calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (d) Calculate and report process and combustion CO<sub>2</sub> emissions separately using the procedures specified in paragraphs (d)(1) through (d)(4) of this section.
  - (1) Calculate CO<sub>2</sub> process emissions from all kilns at the facility using equation H-1 to this section:

$$CO_{2\text{ CMF}} = \sum_{m=1}^k [CO_{2\text{ cli},m} + CO_{2\text{ rm},m}] \quad (\text{Eq. H-1})$$

Where:

CO<sub>2 CMF</sub> = Annual process emissions of CO<sub>2</sub> from cement manufacturing, metric tons.

CO<sub>2 cli,m</sub> = Total annual emissions of CO<sub>2</sub> from clinker production from kiln m, metric tons.

CO<sub>2 rm,m</sub> = Total annual emissions of CO<sub>2</sub> from raw materials from kiln m, metric tons.

k = Total number of kilns at a cement manufacturing facility.

- (2) **CO<sub>2</sub> emissions from clinker production.** Calculate CO<sub>2</sub> emissions from each kiln using Equations H-2 through H-5 of this section.

$$CO_2_{Ck,m} = \sum_{j=1}^p \left[ (Cl_{i,j}) \cdot (EF_{Ck,j}) \cdot \frac{2000}{2205} \right] + \sum_{i=1}^r \left[ (CKD_{i,i}) \cdot (EF_{CKD,i}) \cdot \frac{2000}{2205} \right] \quad (\text{Eq. H-2})$$

Where:

$Cl_{i,j}$  = Quantity of clinker produced in month j from kiln m, tons.

$EF_{Ck,j}$  = Kiln specific clinker emission factor for month j for kiln m, metric tons CO<sub>2</sub>/metric ton clinker computed as specified in Equation H-3 of this section.

$CKD_{i,i}$  = Cement kiln dust (CKD) not recycled to the kiln in quarter i from kiln m, tons.

$EF_{CKD,i}$  = Kiln specific CKD emission factor for quarter i from kiln m, metric tons CO<sub>2</sub>/metric ton CKD computed as specified in Equation H-4 of this section.

p = Number of months for clinker calculation, 12.

r = Number of quarters for CKD calculation, 4.

2000/2205 = Conversion factor to convert tons to metric tons.

(i) **Kiln-Specific Clinker Emission Factor.**

(A) Calculate the kiln-specific clinker emission factor using Equation H-3 of this section.

$$EF_{Ck} = (Cl_{CaO} - Cl_{ncCaO}) \cdot MR_{CaO} + (Cl_{MgO} - Cl_{ncMgO}) \cdot MR_{MgO} \quad (\text{Eq. H-3})$$

Where:

$Cl_{CaO}$  = Monthly total CaO content of Clinker, wt-fraction.

$Cl_{ncCaO}$  = Monthly non-calcined CaO content of Clinker, wt-fraction.

$MR_{CaO}$  = Molecular-weight Ratio of CO<sub>2</sub>/CaO = 0.785.

$Cl_{MgO}$  = Monthly total MgO content of Clinker, wt-fraction.

$Cl_{ncMgO}$  = Monthly non-calcined MgO content of Clinker, wt-fraction.

$MR_{MgO}$  = Molecular-weight Ratio of CO<sub>2</sub>/MgO = 1.092.

(B) Non-calcined CaO is CaO that remains in the clinker in the form of CaCO<sub>3</sub> and CaO in the clinker that entered the kiln as a non-carbonate species. Non-calcined MgO is MgO that remains in the clinker in the form of MgCO<sub>3</sub> and MgO in the clinker that entered the kiln as a non-carbonate species.

(ii) **Kiln-Specific CKD Emission Factor.**

- (A) Calculate the kiln-specific CKD emission factor for CKD not recycled to the kiln using Equation H-4 of this section.

$$EF_{CKD} = (CKD_{CaO} - CKD_{ncCaO}) * MR_{CaO} + (CKD_{MgO} - CKD_{ncMgO}) * MR_{MgO} \quad (\text{Eq. H-4})$$

Where:

$CKD_{CaO}$  = Quarterly total CaO content of CKD not recycled to the kiln, wt-fraction.

$CKD_{ncCaO}$  = Quarterly non-calcined CaO content of CKD not recycled to the kiln, wt-fraction.

$MR_{CaO}$  = Molecular-weight Ratio of  $CO_2/CaO = 0.785$ .

$CKD_{MgO}$  = Quarterly total MgO content of CKD not recycled to the kiln, wt-fraction.

$CKD_{ncMgO}$  = Quarterly non-calcined MgO content of CKD not recycled to the kiln, wt-fraction.

$MR_{MgO}$  = Molecular-weight Ratio of  $CO_2/MgO = 1.092$ .

- (B) Non-calcined CaO is CaO that remains in the CKD in the form of  $CaCO_3$  and CaO in the CKD that entered the kiln as a non-carbonate species. Non-calcined MgO is MgO that remains in the CKD in the form of  $MgCO_3$  and MgO in the CKD that entered the kiln as a non-carbonate species.

- (3) ***CO<sub>2</sub> emissions from raw materials from each kiln.*** Calculate  $CO_2$  emissions from raw materials using equation H-5 to this section:

$$CO_{2\text{ rm},m} = \sum_{i=1}^M \left[ rm * TOC_{rm} * \frac{44}{12} * \frac{2000}{2205} \right] \quad (\text{Eq. H-5})$$

Where:

$rm$  = The amount of raw material  $i$  consumed annually from kiln  $m$ , tons/yr (dry basis) or the amount of raw kiln feed consumed annually from kiln  $m$ , tons/yr (dry basis).

$CO_{2,rm,m}$  = Annual  $CO_2$  emissions from raw materials from kiln  $m$ .

$TOC_{rm}$  = Organic carbon content of raw material  $i$  from kiln  $m$  or organic carbon content of combined raw kiln feed (dry basis) from kiln  $m$ , as determined in § 98.84(c) or using a default factor of 0.2 percent of total raw material weight.

$M$  = Number of raw materials or 1 if calculating emissions based on combined raw kiln feed.

$44/12$  = Ratio of molecular weights,  $CO_2$  to carbon.

$2000/2205$  = Conversion factor to convert tons to metric tons.

- (4) Calculate and report under subpart C of this part (General Stationary Fuel Combustion Sources) the combustion  $CO_2$  emissions from the kiln according to the applicable requirements in subpart C.



[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66461, Oct. 28, 2010; 89 FR 31905, Apr. 25, 2024]

## § 98.84 Monitoring and QA/QC requirements.

- (a) You must determine the weight fraction of total CaO and total MgO in CKD not recycled to the kiln from each kiln using ASTM C114-09, Standard Test Methods for Chemical Analysis of Hydraulic Cement (incorporated by reference, see § 98.7). The monitoring must be conducted quarterly for each kiln from a CKD sample drawn either as CKD is exiting the kiln or from bulk CKD storage.
- (b) You must determine the weight fraction of total CaO and total MgO in clinker from each kiln using ASTM C114-09 Standard Test Methods for Chemical Analysis of Hydraulic Cement (incorporated by reference, see § 98.7). The monitoring must be conducted monthly for each kiln from a monthly clinker sample drawn from bulk clinker storage if storage is dedicated to the specific kiln, or from a monthly arithmetic average of daily clinker samples drawn from the clinker conveying systems exiting each kiln.
- (c) The total organic carbon content (dry basis) of raw materials must be determined annually using ASTM C114-09 Standard Test Methods for Chemical Analysis of Hydraulic Cement (incorporated by reference, see § 98.7) or a similar industry standard practice or method approved for total organic carbon determination in raw mineral materials. The analysis must be conducted either on sample material drawn from bulk raw kiln feed storage or on sample material drawn from bulk raw material storage for each category of raw material (i.e., limestone, sand, shale, iron oxide, and alumina). Facilities that opt to use the default total organic carbon factor provided in § 98.83(d)(3), are not required to monitor for TOC.
- (d) The quantity of clinker produced monthly by each kiln must be determined by direct weight measurement of clinker using the same plant techniques used for accounting purposes, such as reconciling weigh hopper or belt weigh feeder measurements against inventory measurements. As an alternative, facilities may also determine clinker production by direct measurement of raw kiln feed and application of a kiln-specific feed-to-clinker factor. Facilities that opt to use a feed-to-clinker factor must verify the accuracy of this factor on a monthly basis.
- (e) The quantity of CKD not recycled to the kiln generated by each kiln must be determined quarterly using the same plant techniques used for accounting purposes, such as direct weight measurement using weigh hoppers, truck weigh scales, or belt weigh feeders.
- (f) The annual quantity of raw kiln feed or annual quantity of each category of raw materials consumed by the facility (e.g., limestone, sand, shale, iron oxide, and alumina) must be determined monthly by direct weight measurement using the same plant instruments used for accounting purposes, such as weigh hoppers, truck weigh scales, or belt weigh feeders.
- (g) The monthly non-calcined CaO and MgO that remains in the clinker in the form of  $\text{CaCO}_3$  or that enters the kiln as a non-carbonate species may be assumed to be a default value of 0.0 or may be determined monthly by careful chemical analysis of feed material and clinker material from each kiln using well documented analytical and calculational methods or the appropriate industry standard practice.
- (h) The quarterly non-calcined CaO and MgO that remains in the CKD in the form of  $\text{CaCO}_3$  or that enters the kiln as a non-carbonate species may be assumed to be a default value of 0.0 or may be determined quarterly by careful chemical analysis of feed material and CKD material from each kiln using well documented analytical and calculational methods or the appropriate industry standard practice.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66461, Oct. 28, 2010]

## § 98.85 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations in § 98.83 is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations. The owner or operator must document and keep records of the procedures used for all such estimates.

- (a) If the CEMS approach is used to determine combined process and combustion CO<sub>2</sub> emissions, the missing data procedures in § 98.35 apply.
- (b) For CO<sub>2</sub> process emissions from cement manufacturing facilities calculated according to § 98.83(d), if data on the carbonate content (of clinker or CKD), noncalcined content (of clinker or CKD) or the annual organic carbon content of raw materials are missing, facilities must undertake a new analysis.
- (c) For each missing value of monthly clinker production the substitute data value must be the best available estimate of the monthly clinker production based on information used for accounting purposes, or use the maximum tons per day capacity of the system and the number of days per month.
- (d) For each missing value of monthly raw material consumption the substitute data value must be the best available estimate of the monthly raw material consumption based on information used for accounting purposes (such as purchase records), or use the maximum tons per day raw material throughput of the kiln and the number of days per month.

## § 98.86 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) and (b) of this section, as appropriate.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required by § 98.36(e)(2)(vi) and the information listed in this paragraph(a):
  - (1) Monthly clinker production from each kiln at the facility.
  - (2) Annual facility cement production.
  - (3) Number of kilns and number of operating kilns.
  - (4) Annual arithmetic average of total CaO content of clinker at the facility, wt-fraction.
  - (5) Annual arithmetic average of non-calcined CaO content of clinker at the facility, wt-fraction.
  - (6) Annual arithmetic average of total MgO content of clinker at the facility, wt-fraction.
  - (7) Annual arithmetic average of non-calcined MgO content of clinker at the facility, wt-fraction.
  - (8) Annual facility CKD not recycled to the kiln(s), tons.
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must report the information listed in this paragraph (b) for each kiln:
  - (1) Kiln identification number.
  - (2) [Reserved]
  - (3) Annual cement production at the facility.

- (4) Number of kilns and number of operating kilns.
- (5)-(6) [Reserved]
- (7) Method used to determine non-calcined CaO and non-calcined MgO in clinker.
- (8) [Reserved]
- (9) Method used to determine non-calcined CaO and non-calcined MgO in CKD.
- (10) [Reserved]
- (11) Quarterly kiln-specific CKD CO<sub>2</sub> emission factors for each kiln (metric tons CO<sub>2</sub>/metric ton CKD produced).
- (12) [Reserved]
- (13) Name of raw kiln feed or raw material.
- (14) Number of times missing data procedures were used to determine the following information:
  - (i) Clinker production (number of months).
  - (ii) Carbonate contents of clinker (number of months).
  - (iii) Non-calcined content of clinker (number of months).
  - (iv) CKD not recycled to kiln (number of quarters).
  - (v) Non-calcined content of CKD (number of quarters)
  - (vi) Organic carbon contents of raw materials (number of times).
  - (vii) Raw material consumption (number of months).
- (15) Method used to determine the monthly clinker production from each kiln.
- (16) Annual clinker production (metric tons).
- (17) Annual average clinker CO<sub>2</sub> emission factor for the facility, averaged across all kilns (metric tons CO<sub>2</sub>/metric ton clinker produced).
- (18) Annual average CKD CO<sub>2</sub> emission factor for the facility, averaged across all kilns (metric tons CO<sub>2</sub>/metric ton CKD produced).
- (19) Annual arithmetic average of total CaO content of clinker at the facility, wt-fraction.
- (20) Annual arithmetic average of non-calcined CaO content of clinker at the facility, wt-fraction.
- (21) Annual arithmetic average of total MgO content of clinker at the facility, wt-fraction.
- (22) Annual arithmetic average of non-calcined MgO content of clinker at the facility, wt-fraction.
- (23) Annual arithmetic average of total CaO content of CKD not recycled to the kiln(s) at the facility, wt-fraction.
- (24) Annual arithmetic average of non-calcined CaO content of CKD not recycled to the kiln(s) at the facility, wt-fraction.

- (25) Annual arithmetic average of total MgO content of CKD not recycled to the kiln(s) at the facility, wt-fraction.
- (26) Annual arithmetic average of non-calcined MgO content of CKD not recycled to the kiln(s) at the facility, wt-fraction.
- (27) Annual facility CKD not recycled to the kiln(s), tons.
- (28) The amount of raw kiln feed consumed annually at the facility, tons (dry basis).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66461, Oct. 28, 2010; 78 FR 71953, Nov. 29, 2013; 79 FR 63785, Oct. 24, 2014; 89 FR 31905, Apr. 25, 2024]

## § 98.87 Records that must be retained.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then in addition to the records required by § 98.3(g), you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37.
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then in addition to the records required by § 98.3(g), you must retain the records specified in this paragraph (b) for each portland cement manufacturing facility.
  - (1) Documentation of monthly calculated kiln-specific clinker CO<sub>2</sub> emission factor.
  - (2) Documentation of quarterly calculated kiln-specific CKD CO<sub>2</sub> emission factor.
  - (3) Measurements, records and calculations used to determine reported parameters.
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) through (17) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) through (17) of this section.
  - (1) Identify per kiln per month if clinker is measured directly, or is calculated from raw feed (Equation H-2 of § 98.83 and the method in § 98.84(d)).
  - (2) Quantity of raw kiln feed in month from kiln (tons) (Equation H-2 and the method in § 98.84(d)).
  - (3) Kiln-specific factor per kiln per month (ton clinker per ton raw feed) (Equation H-2 and the method in § 98.84(d)).
  - (4) Quantity of clinker produced in month from kiln (tons) (Equation H-2 and the method in § 98.84(d)).
  - (5) Cement kiln dust (CKD) not recycled to the kiln in quarter from kiln (tons) (Equation H-2 and the method in § 98.84(d)).
  - (6) Monthly total CaO content of clinker per kiln (weight fraction) (Equation H-3 of § 98.83).
  - (7) Monthly non-calcined CaO content of clinker per kiln (weight fraction) (Equation H-3).
  - (8) Monthly total MgO content of clinker per kiln (weight fraction) (Equation H-3).
  - (9) Monthly non-calcined MgO content of clinker per kiln (weight fraction) (Equation H-3).
  - (10) Quarterly total CaO content of cement kiln dust not recycled to each kiln (weight fraction) (Equation H-4 of § 98.83).

- (11) Quarterly non-calcined CaO content of cement kiln dust not recycled to each kiln (weight fraction) (Equation H-4).
- (12) Quarterly total MgO content of cement kiln dust not recycled to each kiln (weight fraction) (Equation H-4).
- (13) Quarterly non-calcined MgO content of cement kiln dust not recycled to each kiln (weight fraction) (Equation H-4).
- (14) The amount of each raw material consumed annually per kiln (tons/yr (dry basis)) (Equation H-5 of § 98.83).
- (15) The amount of each raw kiln feed consumed annually per kiln (tons/yr (dry basis)) (Equation H-5).
- (16) Organic carbon content of each raw material per kiln, as determined in § 98.84(c). Default value is 0.002 weight fraction (Equation H-5).
- (17) Organic carbon content of combined raw kiln feed per kiln, as determined in § 98.84(c). Default value is 0.002 weight fraction (Equation H-5).

[75 FR 66461, Oct. 28, 2010, as amended at 79 FR 63785, Oct. 24, 2014]

## § 98.88 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart I—Electronics Manufacturing

**Source:** 75 FR 74818, Dec. 1, 2010, unless otherwise noted.

## § 98.90 Definition of the source category.

- (a) The electronics manufacturing source category consists of any of the production processes listed in paragraphs (a)(1) through (a)(5) of this section that use fluorinated GHGs or N<sub>2</sub>O. Facilities that may use these processes include, but are not limited to, facilities that manufacture micro-electro-mechanical systems (MEMS), liquid crystal displays (LCDs), photovoltaic cells (PV), and semiconductors (including light-emitting diodes (LEDs)).
  - (1) Any electronics production process in which the etching process uses plasma-generated fluorine atoms and other reactive fluorine-containing fragments, that chemically react with exposed thin-films (e.g., dielectric, metals) or substrate (e.g., silicon) to selectively remove portions of material.
  - (2) Any electronics production process in which chambers used for depositing thin films are cleaned periodically using plasma-generated fluorine atoms and other reactive fluorine-containing fragments.
  - (3) Any electronics production process in which wafers are cleaned using plasma generated fluorine atoms or other reactive fluorine-containing fragments to remove residual material from wafer surfaces, including the wafer edge.
  - (4) Any electronics production process in which the chemical vapor deposition (CVD) process or other manufacturing processes use N<sub>2</sub>O.

- (5) Any electronics manufacturing production process in which fluorinated heat transfer fluids are used to cool process equipment, to control temperature during device testing, to clean substrate surfaces and other parts, and for soldering (e.g., vapor phase reflow).

[75 FR 74818, Dec. 1, 2010, as amended at 77 FR 10380, Feb. 22, 2012]

## § 98.91 Reporting threshold.

- (a) You must report GHG emissions under this subpart if electronics manufacturing production processes, as defined in § 98.90, are performed at your facility and your facility meets the requirements of either § 98.2(a)(1) or (2). To calculate total annual GHG emissions for comparison to the 25,000 metric ton CO<sub>2</sub>e per year emission threshold in § 98.2(a)(2), follow the requirements of § 98.2(b), with one exception. Rather than using the calculation methodologies in § 98.93 to calculate emissions from electronics manufacturing production processes, calculate emissions of each fluorinated GHG from electronics manufacturing production processes by using paragraph (a)(1), (2), or (3) of this section, as appropriate, and then sum the emissions of each fluorinated GHG and account for fluorinated heat transfer fluid emissions by using paragraph (a)(4) of this section.
- (1) If you manufacture semiconductors or MEMS you must calculate annual production process emissions resulting from the use of each input gas for threshold applicability purposes using either the default emission factors shown in table I-1 to this subpart and equation I-1A to this section, or the consumption of each input gas, the default emission factors shown in table I-2 to this subpart, and equation I-1B to this section.

$$E_i = S * EF_i * GWP_i * 0.001 \quad (\text{Eq. I-1A})$$

Where:

$E_i$  = Annual production process emissions of gas  $i$  for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$S$  = 100 percent of annual manufacturing capacity of a facility as calculated using equation I-5 to this section (m<sup>2</sup>).

$EF_i$  = Emission factor for gas  $i$  (kg/m<sup>2</sup>) shown in table I-1 to this subpart.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

0.001 = Conversion factor from kg to metric tons.

$i$  = Emitted gas.

$$E_i = C_i * (GWP_i * (1 - U_i) + GWP_{CF_4} * BCF_4 + GWP_{C_2F_6} * BC_2F_6) * 0.001 \quad (\text{Eq. I-1B})$$

Where:

$E_i$  = Annual production process emissions resulting from the use of input gas  $i$  for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$C_i$  = Annual GHG (input gas  $i$ ) purchases or consumption (kg). Only gases that are used in semiconductor or MEMS manufacturing processes listed at § 98.90(a)(1) through (4) must be considered for threshold applicability purposes.

$(1-U_i)$ ,  $BCF_4$ , and  $BC_2F_6$  = Default emission factors for the gas consumption-based threshold applicability determination listed in table I-2 to this subpart.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

0.001 = Conversion factor from kg to metric tons.

$i$  = Input gas.

- (2) If you manufacture LCDs, you must calculate annual production process emissions resulting from the use of each input gas for threshold applicability purposes using either the default emission factors shown in table I-1 to this subpart and equation I-2A to this section or the consumption of each input gas, the default emission factors shown in table I-2 to this subpart, and equation I-2B to this section.

$$E_i = S * EF_i * GWP_i * 0.000001 \quad (\text{Eq. I-2A})$$

Where:

$E_i$  = Annual production process emissions of gas  $i$  for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$S$  = 100 percent of annual manufacturing capacity of a facility as calculated using equation I-5 to this section (m<sup>2</sup>).

$EF_i$  = Emission factor for gas  $i$  (g/m<sup>2</sup>).

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

0.000001 = Conversion factor from g to metric tons.

$i$  = Emitted gas.

$$E_i = C_i * (GWP_i * (1 - U_i) + GWP_{CF_4} * BCF_4 + GWP_{C_2F_6} * BC_2F_6) * 0.001 \quad (\text{Eq. I-2B})$$

Where:

$E_i$  = Annual production process emissions resulting from the use of input gas  $i$  for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$C_i$  = Annual GHG (input gas  $i$ ) purchases or consumption (kg). Only gases that are used in LCD manufacturing processes listed at § 98.90(a)(1) through (4) must be considered for threshold applicability purposes.

$(1-U_i)$ ,  $BCF_4$ , and  $BC_2F_6$  = Default emission factors for the gas consumption-based threshold applicability determination listed in table I-2 to this subpart.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

0.001 = Conversion factor from kg to metric tons.

$i$  = Input gas.

- (3) If you manufacture PVs, you must calculate annual production process emissions resulting from the use of each input gas  $i$  for threshold applicability purposes using gas-appropriate GWP values shown in table A-1 to subpart A of this part, the default emission factors shown in table I-2 to this subpart, and equation I-3 to this section.

$$E_i = C_i * (GWP_i * (1 - U_i) + GWP_{CF_4} * BCF_4 + GWP_{C_2F_6} * BC_2F_6) * 0.001 \quad (\text{Eq. I-3})$$

Where:

$E_i$  = Annual production process emissions resulting from the use of input gas  $i$  for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$C_i$  = Annual fluorinated GHG (input gas  $i$ ) purchases or consumption (kg). Only gases that are used in PV manufacturing processes listed at § 98.90(a)(1) through (4) must be considered for threshold applicability purposes.

$(1 - U_i)$ ,  $BCF_4$ , and  $BC_2F_6$  = Default emission factors for the gas consumption-based threshold applicability determination listed in table I-2 to this subpart.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

0.001 = Conversion factor from kg to metric tons.

$i$  = Input gas.

- (4) You must calculate total annual production process emissions for threshold applicability purposes using equation I-4 to this section.

$$E_T = \delta * \sum_i E_i \quad (\text{Eq. I-4})$$

Where:

$E_T$  = Annual production process emissions of all fluorinated GHGs for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$\delta$  = Factor accounting for fluorinated heat transfer fluid emissions, estimated as 10 percent of total annual production process emissions at a semiconductor facility. Set equal to 1.1 when equation I-4 to this section is used to calculate total annual production process emissions from semiconductor manufacturing. Set equal to 1 when equation I-4 to this section is used to calculate total annual production process emissions from MEMS, LCD, or PV manufacturing.

$E_i$  = Annual production process emissions of gas  $i$  for threshold applicability purposes (metric tons CO<sub>2</sub>e), as calculated in equations I-1a, I-1b, I-2a, I-2b, or I-3 to this section.



i = Emitted gas.

- (b) You must calculate annual manufacturing capacity of a facility using equation I-5 to this section.

$$S = \sum_x^{12} W_x$$

(Eq. I-5)

Where:

S = 100 percent of annual manufacturing capacity of a facility (m<sup>2</sup>).

W<sub>x</sub> = Maximum substrate starts of fab f in month x (m<sup>2</sup> per month).

x = Month.

[75 FR 74818, Dec. 1, 2010, as amended at 77 FR 10380, Feb. 22, 2012; 78 FR 68202, Nov. 13, 2013; 89 FR 31905, Apr. 25, 2024]

## § 98.92 GHGs to report.

- (a) You must report emissions of fluorinated GHGs (as defined in § 98.6), N<sub>2</sub>O, and fluorinated heat transfer fluids (as defined in § 98.6). The fluorinated GHGs and fluorinated heat transfer fluids that are emitted from electronics manufacturing production processes include, but are not limited to, those listed in table I-21 to this subpart. You must individually report, as appropriate:
- (1) Fluorinated GHGs emitted.
  - (2)-(3) [Reserved]
  - (4) N<sub>2</sub>O emitted from chemical vapor deposition and other electronics manufacturing processes.
  - (5) Emissions of fluorinated heat transfer fluids.
  - (6) All fluorinated GHGs and N<sub>2</sub>O consumed.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions from each stationary combustion unit. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C of this part.

[75 FR 74818, Dec. 1, 2010, as amended at 77 FR 10380, Feb. 22, 2012; 78 FR 68202, Nov. 13, 2013; 89 FR 31907, Apr. 25, 2024]

## § 98.93 Calculating GHG emissions.

- (a) You must calculate total annual emissions of each fluorinated GHG emitted by electronics manufacturing production processes from each fab (as defined in § 98.98) at your facility, including each input gas and each by-product gas. You must use either default gas utilization rates and by-product formations rates according to the procedures in paragraph (a)(1), (2), (6), or (7) of this section, as appropriate, or the stack test method according to paragraph (i) of this section, to calculate emissions of each input gas and each by-product gas.

- (1) If you manufacture semiconductors, you must adhere to the procedures in paragraphs (a)(1)(i) through (iii) of this section. You must calculate annual emissions of each input gas and of each by-product gas using equations I-6, I-7, and I-9 to this section. If your fab uses less than 50 kg of a fluorinated GHG in one reporting year, you may calculate emissions as equal to your fab's annual consumption for that specific gas as calculated in equation I-11 to this section, plus any by-product emissions of that gas calculated under paragraph (a) of this section.

$$\text{Processtype}E_i = \sum_{j=1}^N E_{ij} \quad (\text{Eq. I-6})$$

Where:

$\text{Processtype}E_i$  = Annual emissions of input gas  $i$  from the process type on a fab basis (metric tons).

$E_{ij}$  = Annual emissions of input gas  $i$  from process sub-type or process type  $j$  as calculated in equation I-8A to this section (metric tons).

$N$  = The total number of process sub-types  $j$  that depends on the electronics manufacturing fab and emission calculation methodology. If  $E_{ij}$  is calculated for a process type  $j$  in equation I-8A to this section,  $N = 1$ .

$i$  = Input gas.

$j$  = Process sub-type or process type.

$$\text{Processtype}BE_k = \sum_{j=1}^N \sum_i BE_{kij} \quad (\text{Eq. I-7})$$

Where:

$\text{Processtype}BE_k$  = Annual emissions of by-product gas  $k$  from the processes type on a fab basis (metric tons).

$BE_{kij}$  = Annual emissions of by-product gas  $k$  formed from input gas  $i$  used for process sub-type or process type  $j$  as calculated in equation I-8B to this section (metric tons).

$N$  = The total number of process sub-types  $j$  that depends on the electronics manufacturing fab and emission calculation methodology. If  $BE_{kij}$  is calculated for a process type  $j$  in equation I-8B to this section,  $N = 1$ .

$i$  = Input gas.

$j$  = Process sub-type, or process type.

$k$  = By-product gas.

- (i) You must calculate annual fab-level emissions of each fluorinated GHG used for the plasma etching/wafer cleaning process type using default utilization and by-product formation rates as shown in table I-3 or I-4 to this subpart, and by using equations I-8A and I-8B to this section.

$$E_{ij} = C_{ij} * (1 - U_{ij}) * \left(1 - (a_{ij} * d_{ij} * UT_{ij})\right) * 0.001 \quad (\text{Eq. I-8A})$$

Where:

$E_{ij}$  = Annual emissions of input gas  $i$  from process sub-type or process type  $j$ , on a fab basis (metric tons).

$C_{ij}$  = Amount of input gas  $i$  consumed for process sub-type or process type  $j$ , as calculated in equation I-13 to this section, on a fab basis (kg).

$U_{ij}$  = Process utilization rate for input gas  $i$  for process sub-type or process type  $j$  (expressed as a decimal fraction).

$a_{ij}$  = Fraction of input gas  $i$  used in process sub-type or process type  $j$  with abatement systems, on a fab basis (expressed as a decimal fraction).

$d_{ij}$  = Fraction of input gas  $i$  destroyed or removed when fed into abatement systems by process tools where process sub-type, or process type  $j$  is used, on a fab basis, calculated by taking the tool weighted average of the claimed DREs for input gas  $i$  on tools that use process type or process sub-type  $j$  (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f).

$UT_{ij}$  = The average uptime factor of all abatement systems connected to process tools in the fab using input gas  $i$  in process sub-type or process type  $j$ , as calculated in equation I-15 to this section, on a fab basis (expressed as a decimal fraction).

0.001 = Conversion factor from kg to metric tons.

$i$  = Input gas.

$j$  = Process sub-type or process type.

$$BE_{kij} = B_{kij} * C_{ij} * \left(1 - (a_{kij} * d_{kij} * UT_{kij})\right) * 0.001 \quad (\text{Eq. I-8B})$$

Where:

$BE_{kij}$  = Annual emissions of by-product gas  $k$  formed from input gas  $i$  from process sub-type or process type  $j$ , on a fab basis (metric tons).

$B_{kij}$  = By-product formation rate of gas  $k$  created as a by-product per amount of input gas  $i$  (kg) consumed by process sub-type or process type  $j$  (kg). If all input gases consumed by a chamber cleaning process sub-type are non-carbon containing input gases, this is zero when the combination of the non-carbon containing input gas and chamber cleaning process sub-type is never used to clean chamber walls on equipment that process carbon-containing films during the year (e.g., when  $NF_3$  is used in remote plasma cleaning processes to only clean chambers that never process carbon-containing films during the year). If all input gases consumed by an etching and wafer cleaning process sub-type are non-carbon containing input gases, this is zero when the combination of the non-carbon containing input gas and etching and wafer cleaning process sub-type is never used to etch or wafer clean carbon-containing films during the year.

$C_{ij}$  = Amount of input gas  $i$  consumed for process sub-type, or process type  $j$ , as calculated in equation I-13 to this section, on a fab basis (kg).

$a_{kij}$  = Fraction of input gas  $i$  used for process sub-type, or process type  $j$  with abatement systems, on a fab basis (expressed as a decimal fraction).

$d_{kij}$  = Fraction of by-product gas  $k$  destroyed or removed in when fed into abatement systems by process tools where process sub-type or process type  $j$  is used, on a fab basis, calculated by taking the tool weighted average of the claimed DREs for by-product gas  $k$  on tools that use input gas  $i$  in process type or process sub-type  $j$  (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f).

$UT_{kij}$  = The average uptime factor of all abatement systems connected to process tools in the fab emitting by-product gas  $k$ , formed from input gas  $i$  in process sub-type or process type  $j$ , on a fab basis (expressed as a decimal fraction). For this equation,  $UT_{kij}$  is assumed to be equal to  $UT_{ij}$  as calculated in equation I-15 to this section.

0.001 = Conversion factor from kg to metric tons.

$i$  = Input gas.

$j$  = Process sub-type or process type.

$k$  = By-product gas.

- (ii) You must calculate annual fab-level emissions of each fluorinated GHG used for each of the process sub-types associated with the chamber cleaning process type, including in-situ plasma chamber clean, remote plasma chamber clean, and in-situ thermal chamber clean, using default utilization and by-product formation rates as shown in table I-3 or I-4 to this subpart, and by using equations I-8A and I-8B to this section.
  - (iii) If default values are not available for a particular input gas and process type or sub-type combination in tables I-3 or I-4, you must follow the procedures in paragraph (a)(6) of this section.
- (2) If you manufacture MEMS or PVs and use semiconductor tools and processes, you may use § 98.3(a)(1) to calculate annual fab-level emissions for those processes. For all other tools and processes used to manufacture MEMs, LCD and PV, you must calculate annual fab-level emissions of each fluorinated GHG used for the plasma etching and chamber cleaning process types using default utilization and by-product formation rates as shown in table I-5, I-6, or I-7 to this subpart, as appropriate, and by using equations I-8A and I-8B to this section. If default values are not available for a particular input gas and process type or sub-type combination in tables I-5, I-6, or I-7 to this subpart, you must follow the procedures in paragraph (a)(6) of this section. If your fab uses less than 50 kg of a fluorinated GHG in one reporting year, you may calculate emissions as equal to your fab's annual consumption for that specific gas as calculated in equation I-11 to this section, plus any by-product emissions of that gas calculated under this paragraph (a).
- (3)-(5) [Reserved]
- (6) If you are required, or elect, to perform calculations using default emission factors for gas utilization and by-product formation rates according to the procedures in paragraph (a)(1) or (2) of this section, and default values are not available for a particular input gas and process type or sub-type

combination in tables I-3, I-4, I-5, I-6, or I-7 to this subpart, you must use a utilization rate ( $U_{ij}$ ) of 0.2 (i.e., a  $1-U_{ij}$  of 0.8) and by-product formation rates of 0.15 for  $CF_4$  and 0.05 for  $C_2F_6$  and use equations I-8A and I-8B to this section.

- (7) If your fab employs hydrocarbon-fuel-based combustion emissions control systems (HC fuel CECS), including, but not limited to, abatement systems as defined at § 98.98, that were purchased and installed on or after January 1, 2025, to control emissions from tools that use either  $NF_3$  in remote plasma cleaning processes or  $F_2$  as an input gas in any process type or sub-type, you must calculate the amount  $CF_4$  produced within and emitted from such systems using equation I-9 to this section using default utilization and by-product formation rates as shown in table I-3 or I-4 to this subpart. A HC fuel CECS is assumed not to form  $CF_4$  from  $F_2$  if the electronics manufacturer can certify that the rate of conversion from  $F_2$  to  $CF_4$  is <0.1% for that HC fuel CECS.

$$EAB_{CF_4} = \sum_j C_{F_2,j} \cdot (1 - U_{F_2,j}) \cdot a_{F_2,j} \cdot UT_{F_2,j} \cdot AB_{CF_4,F_2} + C_{NF_3,RPC} \cdot B_{F_2,NF_3} \cdot a_{NF_3,RPC} \cdot$$

$$UT_{NF_3,RPC,F_2} \cdot AB_{CF_4,F_2} \quad (Eq. I-9)$$

Where:

$EAB_{CF_4}$  = Emissions of  $CF_4$  from HC fuel CECS when direct reaction between hydrocarbon fuel and  $F_2$  is not certified not to occur by the emissions control system manufacturer or electronics manufacturer, kg.

$C_{F_2,j}$  = Amount of  $F_2$  consumed for process type or sub-type j, as calculated in equation I-13 to this section, on a fab basis (kg).

$U_{F_2,j}$  = Process utilization rate for  $F_2$  for process type or sub-type j (expressed as a decimal fraction).

$a_{F_2,j}$  = Within process sub-type or process type j, fraction of  $F_2$  used in process tools with HC fuel CECS that are not certified not to form  $CF_4$ , on a fab basis, where the numerator is the number of tools that are equipped with HC fuel CECS that are not certified not to form  $CF_4$  that use  $F_2$  in process type j and the denominator is the total number of tools in the fab that use  $F_2$  in process type j (expressed as a decimal fraction).

$UT_{F_2,j}$  = The average uptime factor of all HC fuel CECS connected to process tools in the fab using  $F_2$  in process sub-type or process type j (expressed as a decimal fraction).

$AB_{CF_4,F_2}$  = Mass fraction of  $F_2$  in process exhaust gas that is converted into  $CF_4$  by direct reaction with hydrocarbon fuel in a HC fuel CECS. The default value of  $AB_{CF_4,F_2} = 0.116$ .

$C_{NF_3,RPC}$  = Amount of  $NF_3$  consumed in remote plasma cleaning processes, as calculated in equation I-13 to this section, on a fab basis (kg).

$B_{F_2,NF_3}$  = By-product formation rate of  $F_2$  created as a by-product per amount of  $NF_3$  (kg) consumed in remote plasma cleaning processes (kg).

$a_{NF_3,RPC}$  = Within remote plasma cleaning processes, fraction of  $NF_3$  used in process tools with HC fuel CECS that are not certified not to form  $CF_4$ , where the numerator is the number of tools running remote plasma cleaning processes that are equipped with HC fuel CECS that are not certified not to form  $CF_4$  that use  $NF_3$  and the denominator is the total number of tools that run remote plasma clean processes in the fab that use  $NF_3$  (expressed as decimal fraction).

$UT_{NF_3,RPC,F2}$  = The average uptime factor of all HC fuel CECS connected to process tools in the fab emitting by-product gas  $F_2$ , formed from input gas  $NF_3$  in remote plasma cleaning processes, on a fab basis (expressed as a decimal fraction). For this equation,  $UT_{NF_3,RPC,F2}$  is assumed to be equal to  $UT_{NF_3,RPC}$  as calculated in equation I-15 to this section.

j = Process type or sub-type.

- (b) You must calculate annual fab-level  $N_2O$  emissions from all chemical vapor deposition processes and from the aggregate of all other electronics manufacturing production processes using Equation I-10 of this subpart and the methods in paragraphs (b)(1) and (2) of this section. If your fab uses less than 50 kg of  $N_2O$  in one reporting year, you may calculate fab emissions as equal to your fab's annual consumption for  $N_2O$  as calculated in Equation I-11 of this subpart.

$$E(N_2O)_j = C_{N_2O,j} * (1 - U_{N_2O,j}) * (1 - (a_{N_2O,j} * d_{N_2O,j} * UT_{N_2O})) * 0.001 \quad (\text{Eq. I-10})$$

Where:

$E(N_2O)_j$  = Annual emissions of  $N_2O$  for  $N_2O$ -using process j, on a fab basis (metric tons).

$C_{N_2O,j}$  = Amount of  $N_2O$  consumed for  $N_2O$ -using process j, as calculated in Equation I-13 of this subpart and apportioned to  $N_2O$  process j, on a fab basis (kg).

$U_{N_2O,j}$  = Process utilization factor for  $N_2O$ -using process j (expressed as a decimal fraction) from Table I-8 of this subpart.

$a_{N_2O,j}$  = Fraction of  $N_2O$  used in  $N_2O$ -using process j with abatement systems, on a fab basis (expressed as a decimal fraction).

$d_{N_2O,j}$  = Fraction of  $N_2O$  for  $N_2O$ -using process j destroyed or removed in abatement systems connected to process tools where process j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f).

$UT_{N_2O}$  = The average uptime factor of all the abatement systems connected to process tools in the fab that use  $N_2O$ , as calculated in Equation I-15 of this subpart, on a fab basis (expressed as a decimal fraction). For purposes of calculating the abatement system uptime for  $N_2O$  using process tools, in Equation I-15 of this subpart, the only input gas i is  $N_2O$ , j is the  $N_2O$  using process, and p is the  $N_2O$  abatement system connected to the  $N_2O$  using tool.

0.001 = Conversion factor from kg to metric tons.

j = Type of N<sub>2</sub>O-using process, either chemical vapor deposition or all other N<sub>2</sub>O-using manufacturing processes.

- (1) You must use the factor for N<sub>2</sub>O utilization for chemical vapor deposition processes as shown in Table I-8 to this subpart.
- (2) You must use the factor for N<sub>2</sub>O utilization for all other manufacturing production processes other than chemical vapor deposition as shown in Table I-8 to this subpart.
- (c) You must calculate total annual input gas i consumption on a fab basis for each fluorinated GHG and N<sub>2</sub>O using Equation I-11 of this subpart. Where a gas supply system serves more than one fab, Equation I-11 is applied to that gas which has been apportioned to each fab served by that system using the apportioning factors determined in accordance with § 98.94(c).

$$C_i = (I_{Bi} - I_{Ei} + A_i - D_i) \quad (\text{Eq. I-11})$$

where:

C<sub>i</sub> = Annual consumption of input gas i, on a fab basis (kg per year).

I<sub>Bi</sub> = Inventory of input gas i stored in containers at the beginning of the reporting year, including heels, on a fab basis (kg). For containers in service at the beginning of a reporting year, account for the quantity in these containers as if they were full.

I<sub>Ei</sub> = Inventory of input gas i stored in containers at the end of the reporting year, including heels, on a fab basis (kg). For containers in service at the end of a reporting year, account for the quantity in these containers as if they were full.

A<sub>i</sub> = Acquisitions of input gas i during the year through purchases or other transactions, including heels in containers returned to the electronics manufacturing facility, on a fab basis (kg).

D<sub>i</sub> = Disbursements of input gas i through sales or other transactions during the year, including heels in containers returned by the electronics manufacturing facility to the chemical supplier, as calculated using Equation I-12 of this subpart, on a fab basis (kg).

i = Input gas.

- (d) You must calculate disbursements of input gas i using fab-wide gas-specific heel factors, as determined in § 98.94(b), and by using Equation I-12 of this subpart. Where a gas supply system serves more than one fab, Equation I-12 is applied to that gas which has been apportioned to each fab served by that system using the apportioning factors determined in accordance with § 98.94(c).

$$D_i = \sum_{l=1}^M (h_{il} * N_{il} * F_{il}) + X_i \quad (\text{Eq. I-12})$$

where:

D<sub>i</sub> = Disbursements of input gas i through sales or other transactions during the reporting year on a fab basis, including heels in containers returned by the electronics manufacturing fab to the gas distributor (kg).



$h_{ij}$  = Fab-wide gas-specific heel factor for input gas  $i$  and container size and type  $I$  (expressed as a decimal fraction), as determined in § 98.94(b). If your fab uses less than 50 kg of a fluorinated GHG or  $N_2O$  in one reporting year, you may assume that any  $h_{ij}$  for that fluorinated GHG or  $N_2O$  is equal to zero.

$N_{ij}$  = Number of containers of size and type  $I$  used at the fab and returned to the gas distributor containing the standard heel of input gas  $i$ .

$F_{ij}$  = Full capacity of containers of size and type  $I$  containing input gas  $i$  (kg).

$X_i$  = Disbursements under exceptional circumstances of input gas  $i$  through sales or other transactions during the year, on a fab basis (kg). These include returns of containers whose contents have been weighed due to an exceptional circumstance as specified in § 98.94(b)(4).

$i$  = Input gas.

$I$  = Size and type of gas container.

$M$  = The total number of different sized container types on a fab basis. If only one size and container type is used for an input gas  $i$ ,  $M = 1$ .

(e) You must calculate the amount of input gas  $i$  consumed, on a fab basis, for each process sub-type or process type  $j$ , using equation I-13 to this section. Where a gas supply system serves more than one fab, equation I-13 to this section is applied to that gas which has been apportioned to each fab served by that system using the apportioning factors determined in accordance with § 98.94(c). If you elect to calculate emissions using the stack test method in paragraph (i) of this section and to use this paragraph (e) to calculate the fraction each fluorinated input gas  $i$  exhausted from tools with abatement systems and the fraction of each by-product gas  $k$  exhausted from tools with abatement systems, you may substitute "The set of tools with abatement systems" for "Process sub-type or process type" in the definition of " $j$ " in equation I-13 to this section.

$$C_{ij} = f_{ij} * C_i \text{ (Eq. I-13)}$$

where:

$C_{ij}$  = The annual amount of input gas  $i$  consumed, on a fab basis, for process sub-type or process type  $j$  (kg).

$f_{ij}$  = Process sub-type-specific or process type-specific  $j$ , input gas  $i$  apportioning factor (expressed as a decimal fraction), as determined in accordance with § 98.94(c).

$C_i$  = Annual consumption of input gas  $i$ , on a fab basis, as calculated using Equation I-11 of this subpart (kg).

$i$  = Input gas.

$j$  = Process sub-type or process type.

(f) [Reserved]



- (g) If you report controlled emissions pursuant to § 98.94(f), you must calculate the uptime of all the abatement systems for each combination of input gas or by-product gas, and process sub-type or process type, by using Equation I-15 of this subpart.

$$UT_{ij} = 1 - \frac{\sum_p Td_{ijp}}{\sum_p UT_{ijp}} \quad (\text{Eq. I-15})$$

Where:

$UT_{ij}$  = The average uptime factor of all abatement systems connected to process tools in the fab using input gas  $i$  in process sub-type or process type  $j$  (expressed as a decimal fraction). The average uptime factor may be set to one (1) if all the abatement systems for the relevant input gas  $i$  and process sub-type or type  $j$  are interlocked with all the tools using input gas  $i$  in process sub-type or type  $j$  and feeding the abatement systems such that no gas can flow to the tools if the abatement systems are not in operational mode.

$Td_{ijp}$  = The total time, in minutes, that abatement system  $p$ , connected to process tool(s) in the fab using input gas  $i$  in process sub-type or process type  $j$ , is not in operational mode, as defined in § 98.98, when at least one of the tools connected to abatement system  $p$  is in operation. If your fab uses redundant abatement systems, you may account for  $Td_{ijp}$  as specified in § 98.94(f)(4)(vi).

$UT_{ijp}$  = Total time, in minutes per year, in which abatement system  $p$  has at least one associated tool in operation. For determining the amount of tool operating time, you may assume that tools that were installed for the whole of the year were operated for 525,600 minutes per year. For tools that were installed or uninstalled during the year, you must prorate the operating time to account for the days in which the tool was not installed; treat any partial day that a tool was installed as a full day (1,440 minutes) of tool operation. For an abatement system that has more than one connected tool, the tool operating time is 525,600 minutes per year if at least one tool was installed at all times throughout the year. If you have tools that are idle with no gas flow through the tool for part of the year, you may calculate total tool time using the actual time that gas is flowing through the tool.

$i$  = Input gas.

$j$  = Process sub-type or process type.

$p$  = Abatement system.

- (h) If you use fluorinated heat transfer fluids, you must calculate the annual emissions of fluorinated heat transfer fluids on a fab basis using the mass balance approach described in Equation I-16 of this subpart.

$$EH_i = \text{density}_i * (I_{iB} + P_i - N_i + R_i - I_{iE} - D_i) * 0.001 \quad (\text{Eq. I-16})$$

where:

$EH_i$  = Emissions of fluorinated heat transfer fluid  $i$ , on a fab basis (metric tons/year).

$\text{Density}_i$  = Density of fluorinated heat transfer fluid  $i$  (kg/l).

$I_{iB}$  = Inventory of fluorinated heat transfer fluid  $i$ , on a fab basis, in containers other than equipment at the beginning of the reporting year (in stock or storage) (I). The inventory at the beginning of the reporting year must be the same as the inventory at the end of the previous reporting year.

$P_i$  = Acquisitions of fluorinated heat transfer fluid  $i$ , on a fab basis, during the reporting year (I), including amounts purchased from chemical suppliers, amounts purchased from equipment suppliers with or inside of equipment, and amounts returned to the facility after off-site recycling.

$N_i$  = Total nameplate capacity (full and proper charge) of equipment that uses fluorinated heat transfer fluid  $i$  and that is newly installed in the fab during the reporting year (I).

$R_i$  = Total nameplate capacity (full and proper charge) of equipment that uses fluorinated heat transfer fluid  $i$  and that is removed from service in the fab during the reporting year (I).

$I_{iE}$  = Inventory of fluorinated heat transfer fluid  $i$ , on a fab basis, in containers other than equipment at the end of the reporting year (in stock or storage) (I). The inventory at the beginning of the reporting year must be the same as the inventory at the end of the previous reporting year.

$D_i$  = Disbursements of fluorinated heat transfer fluid  $i$ , on a fab basis, during the reporting year, including amounts returned to chemical suppliers, sold with or inside of equipment, and sent off-site for verifiable recycling or destruction (I). Disbursements should include only amounts that are properly stored and transported so as to prevent emissions in transit.

0.001 = Conversion factor from kg to metric tons.

$i$  = Fluorinated heat transfer fluid.

(1) If you use a fluorinated chemical both as a fluorinated heat transfer fluid and in other applications, you may calculate and report either emissions from all applications or from only those specified in the definition of fluorinated heat transfer fluids in § 98.6.

(2) [Reserved]

(i) **Stack test method.** As an alternative to the default emission factor method in paragraph (a) of this section, you may calculate fab-level fluorinated GHG emissions using fab-specific emission factors developed from stack testing. In this case, you must comply with the stack test method specified in paragraph (i)(3) of this section.

(1)-(2) [Reserved]

(3) **Stack system stack test method.** For each stack system in the fab, measure the emissions of each fluorinated GHG from the stack system by conducting an emission test. In addition, measure the fab-specific consumption of each fluorinated GHG by the tools that are vented to the stack systems tested. Measure emissions and consumption of each fluorinated GHG as specified in § 98.94(j). Develop fab-specific emission factors and calculate fab-level fluorinated GHG emissions using the procedures specified in paragraphs (i)(3)(i) through (viii) of this section. All emissions test data and procedures used in developing emission factors must be documented and recorded according to § 98.97.

- (i) You must measure the fab-specific fluorinated GHG consumption of the tools that are vented to the stack systems during the emission test as specified in § 98.94(j)(3). Calculate the consumption for each fluorinated GHG for the test period.
- (ii) You must calculate the emissions of each fluorinated GHG consumed as an input gas using equation I-17 to this section and each fluorinated GHG formed as a by-product gas using equation I-18 to this section and the procedures specified in paragraphs (i)(3)(ii)(A) through (E) of this section. If a stack system is comprised of multiple stacks, you must sum the emissions from each stack in the stack system when using equation I-17 or equation I-18 to this section.

$$E_{is} = MW_i * Q_s * \frac{1}{SV} * \frac{1}{10^3} * \sum_{m=1}^N \frac{X_{ism}}{10^9} * \Delta t_m \quad (\text{Eq. I-17})$$

Where:

$E_{is}$  = Total fluorinated GHG input gas i, emitted from stack system s, during the sampling period (kg).

$X_{ism}$  = Average concentration of fluorinated GHG input gas i in stack system s, during the time interval m (ppbv).

$MW_i$  = Molecular weight of fluorinated GHG input gas i (g/g-mole).

$Q_s$  = Flow rate of the stack system s, during the sampling period (m<sup>3</sup>/min).

$SV$  = Standard molar volume of gas (0.0240 m<sup>3</sup>/g-mole at 68 °F and 1 atm).

$\Delta t_m$  = Length of time interval m (minutes). Each time interval in the FTIR sampling period must be less than or equal to 60 minutes (for example an 8 hour sampling period would consist of at least 8 time intervals).

$1/10^3$  = Conversion factor (1 kilogram/1,000 grams).

i = Fluorinated GHG input gas.

s = Stack system.

N = Total number of time intervals m in sampling period.

m = Time interval.

$$E_{ks} = MW_k * Q_s * \frac{1}{SV} * \frac{1}{10^3} * \sum_{m=1}^N \frac{X_{ksm}}{10^9} * \Delta t_m \quad (\text{Eq. I-18})$$

Where:

$E_{ks}$  = Total fluorinated GHG by-product gas k, emitted from stack system s, during the sampling period (kg).

$X_{ks}$  = Average concentration of fluorinated GHG by-product gas k in stack system s, during the time interval m (ppbv).

$MW_k$  = Molecular weight of the fluorinated GHG by-product gas k (g/g-mole).

$Q_s$  = Flow rate of the stack system  $s$ , during the sampling period ( $m^3/min$ ).

$SV$  = Standard molar volume of gas ( $0.0240 m^3/g\text{-mole}$  at  $68^\circ F$  and  $1 atm$ ).

$\Delta t_m$  = Length of time interval  $m$  (minutes). Each time interval in the FTIR sampling period must be less than or equal to 60 minutes (for example an 8 hour sampling period would consist of at least 8 time intervals).

$1/10^3$  = Conversion factor (1 kilogram/1,000 grams).

$k$  = Fluorinated GHG by-product gas.

$s$  = Stack system.

$N$  = Total number of time intervals  $m$  in sampling period.

$m$  = Time interval.

- (A) If a fluorinated GHG is consumed during the sampling period, but emissions are not detected, use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of " $X_{ism}$ " in equation I-17 to this section.
  - (B) If a fluorinated GHG is consumed during the sampling period and detected intermittently during the sampling period, use the detected concentration for the value of " $X_{ism}$ " in equation I-17 to this section when available and use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of " $X_{ism}$ " when the fluorinated GHG is not detected.
  - (C) If an expected or possible by-product, as listed in table I-17 to this subpart, is detected intermittently during the sampling period, use the measured concentration for " $X_{ksm}$ " in equation I-18 to this section when available and use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of " $X_{ksm}$ " when the fluorinated GHG is not detected.
  - (D) If a fluorinated GHG is not consumed during the sampling period and is an expected by-product gas as listed in table I-17 to this subpart and is not detected during the sampling period, use one-half of the field detection limit you determined for that fluorinated GHG according to § 98.94(j)(2) for the value of " $X_{ksm}$ " in equation I-18 to this section.
  - (E) If a fluorinated GHG is not consumed during the sampling period and is a possible by-product gas as listed in table I-17 to this subpart, and is not detected during the sampling period, then assume zero emissions for that fluorinated GHG for the tested stack system.
- (iii) You must calculate a fab-specific emission factor for each fluorinated GHG input gas consumed (in kg of fluorinated GHG emitted per kg of input gas  $i$  consumed) in the tools that vent to stack systems, as applicable, using equations I-19A and I-19B to this section or equations I-19A and I-19C to this section. Use equation I-19A to this section to calculate the controlled emissions for each carbon-containing fluorinated GHG that would result during the sampling period if the utilization rate for the input gas were equal to 0.2 ( $E_{imax,f}$ ). If  $\sum_s E_{i,s}$  (the total measured emissions of the fluorinated GHG across all stack systems, calculated based on the results of equation I-17 to this section) is less than or equal to  $E_{imax,f}$  calculated in equation

I-19A to this section, use equation I-19B to this section to calculate the emission factor for that fluorinated GHG. If  $\sum_s E_{i,s}$  is larger than the  $E_{i\max,f}$  calculated in equation I-19A to this section, use equation I-19C to this section to calculate the emission factor and treat the difference between the total measured emissions  $\sum_s E_{i,s}$  and the maximum expected controlled emissions  $E_{i\max,f}$  as a by-product of the other input gases, using equation I-20 to this section. For all fluorinated GHGs that do not contain carbon, use equation I-19B to this section to calculate the emission factor for that fluorinated GHG.

$$E_{i\max,f} = 0.8 \cdot \text{Activity}_{if} \cdot (1 - UT_f \cdot a_{if} \cdot d_{if}) \quad (\text{Eq. I-19A})$$

Where:

$E_{i\max,f}$  = Maximum expected controlled emissions of gas i from its use an input gas during the stack testing period, from fab f (max kg emitted).

$\text{Activity}_{if}$  = Consumption of fluorinated GHG input gas i, for fab f, in the tools vented to the stack systems being tested, during the sampling period, as determined following the procedures specified in § 98.94(j)(3) (kg consumed).

$UT_f$  = The total uptime of all abatement systems for fab f, during the sampling period, as calculated in equation I-23 to this section (expressed as decimal fraction). If the stack system does not have abatement systems on the tools vented to the stack system, the value of this parameter is zero.

$a_{if}$  = Fraction of input gas i emitted from tools with abatement systems in fab f (expressed as a decimal fraction), as calculated in equation I-24C to this section.

$d_{if}$  = Fraction of fluorinated GHG input gas i destroyed or removed when fed into abatement systems by process tools in fab f, as calculated in equation I-24A to this section (expressed as decimal fraction).

f = Fab.

i = Fluorinated GHG input gas.

$$EF_{if} = \frac{\sum_s (E_{i,s})}{\text{Activity}_{if} \cdot \left( UT_f + \left( \frac{1 - UT_f}{1 - (a_{if} \cdot d_{if})} \right) \right)} \quad (\text{Eq. I-19B})$$

Where:

$EF_{if}$  = Emission factor for fluorinated GHG input gas i, from fab f, representing 100 percent abatement system uptime (kg emitted/kg input gas consumed).

$E_{i,s}$  = Mass emission of fluorinated GHG input gas i from stack system s during the sampling period (kg emitted).

$\text{Activity}_{if}$  = Consumption of fluorinated GHG input gas i, for fab f during the sampling period, as determined following the procedures specified in § 98.94(j)(3) (kg consumed).

$UT_f$  = The total uptime of all abatement systems for fab  $f$ , during the sampling period, as calculated in equation I-23 to this section (expressed as decimal fraction). If the stack system does not have abatement systems on the tools vented to the stack system, the value of this parameter is zero.

$a_{if}$  = Fraction of fluorinated GHG input gas  $i$  exhausted from tools with abatement systems in fab  $f$  (expressed as a decimal fraction), as calculated in equation I-24C to this section.

$d_{if}$  = Fraction of fluorinated GHG input gas  $i$  destroyed or removed when fed into abatement systems by process tools in fab  $f$ , as calculated in equation I-24A to this section (expressed as decimal fraction). If the stack system does not have abatement systems on the tools vented to the stack system, the value of this parameter is zero.

$f$  = Fab.

$i$  = Fluorinated GHG input gas.

$s$  = Stack system.

$$EF_{if} = 0.8 \cdot (1 - a_{if} \cdot d_{if}) \quad (\text{Eq. I-19C})$$

$EF_{if}$  = Emission factor for input gas  $i$ , from fab  $f$ , representing a 20-percent utilization rate and a 100-percent abatement system uptime (kg emitted/kg input gas consumed).

$a_{if}$  = Fraction of input gas  $i$  emitted from tools with abatement systems in fab  $f$  (expressed as a decimal fraction), as calculated in equation I-24C to this section.

$d_{if}$  = Fraction of fluorinated GHG input gas  $i$  destroyed or removed when fed into abatement systems by process tools in fab  $f$ , as calculated in equation I-24A to this section (expressed as decimal fraction).

$f$  = Fab.

$i$  = Fluorinated GHG input gas.

- (iv) You must calculate a fab-specific emission factor for each fluorinated GHG formed as a by-product (in kg of fluorinated GHG per kg of total fluorinated GHG consumed) in the tools vented to stack systems, as applicable, using equation I-20 to this section. When calculating the by-product emission factor for an input gas for which  $\sum_s E_{i,s}$  equals or exceeds  $E_{i\max,f}$ , exclude the consumption of that input gas from the term " $\sum(\text{Activity}_{if})$ ."

$$EF_{kf} = \frac{\sum_s (E_{ks})}{\sum_i \text{Activity}_{if} \cdot \left( UT_f + \left( \frac{1 - UT_f}{1 - (a_{kif} \cdot d_{kif})} \right) \right)} \quad (\text{Eq. I-20})$$

Where:

$EF_{kf}$  = Emission factor for fluorinated GHG by-product gas  $k$ , from fab  $f$ , representing 100 percent abatement system uptime (kg emitted/kg of all input gases consumed in tools vented to stack systems).

$E_{ks}$  = Mass emission of fluorinated GHG by-product gas k, emitted from stack system s, during the sampling period (kg emitted).

$Activity_{if}$  = Consumption of fluorinated GHG input gas i for fab f in tools vented to stack systems during the sampling period as determined following the procedures specified in § 98.94(j)(3) (kg consumed).

$UT_f$  = The total uptime of all abatement systems for fab f, during the sampling period, as calculated in equation I-23 to this section (expressed as decimal fraction).

$a_{kif}$  = Fraction of by-product k emitted from tools using input gas i with abatement systems in fab f (expressed as a decimal fraction), as calculated using equation I-24D to this section.

$d_{kif}$  = Fraction of fluorinated GHG by-product gas k generated from input gas i destroyed or removed when fed into abatement systems by process tools in fab f, as calculated in equation I-24B to this section (expressed as decimal fraction).

f = Fab.

i = Fluorinated GHG input gas.

k = Fluorinated GHG by-product gas.

s = Stack system.

(v) You must calculate annual fab-level emissions of each fluorinated GHG consumed using equation I-21 to this section.

$$E_{if} = EF_{if} \cdot C_{if} \cdot UT_f + \frac{EF_{if}}{(1 - (a_{if} \cdot d_{if}))} \cdot C_{if} \cdot (1 - UT_f) \quad (\text{Eq. I-21})$$

Where:

$E_{if}$  = Annual emissions of fluorinated GHG input gas i (kg/year) from the stack systems for fab f.

$EF_{if}$  = Emission factor for fluorinated GHG input gas i emitted from fab f, as calculated in equation I-19 to this section (kg emitted/kg input gas consumed).

$C_{if}$  = Total consumption of fluorinated GHG input gas i in tools that are vented to stack systems, for fab f, for the reporting year, as calculated using equation I-13 to this section (kg/year).

$UT_f$  = The total uptime of all abatement systems for fab f, during the reporting year, as calculated using equation I-23 to this section (expressed as a decimal fraction).

$a_{if}$  = Fraction of fluorinated GHG input gas i emitted from tools with abatement systems in fab f (expressed as a decimal fraction), as calculated using equation I-24C or I-24D to this section.



$d_{if}$  = Fraction of fluorinated GHG input gas  $i$  destroyed or removed when fed into abatement systems by process tools in fab  $f$  that are included in the stack testing option, as calculated in equation I-24A to this section (expressed as decimal fraction).

$f$  = Fab.

$i$  = Fluorinated GHG input gas.

- (vi) You must calculate annual fab-level emissions of each fluorinated GHG by-product formed using equation I-22 to this section.

$$E_{kf} = EF_{kf} \cdot \sum_i C_{if} \cdot UT_f + EF_{kf} \cdot \sum_i \frac{C_{if} \cdot (1 - UT_f)}{1 - a_{kif} \cdot d_{kif}} \quad (\text{Eq. I-22})$$

Where:

$E_{kf}$  = Annual emissions of fluorinated GHG by-product gas  $k$  (kg/year) from the stack for fab  $f$ .

$EF_{kf}$  = Emission factor for fluorinated GHG by-product gas  $k$ , emitted from fab  $f$ , as calculated in equation I-20 to this section (kg emitted/kg of all fluorinated input gases consumed).

$C_{if}$  = Total consumption of fluorinated GHG input gas  $i$  in tools that are vented to stack systems, for fab  $f$ , for the reporting year, as calculated using equation I-13 to this section.

$UT_f$  = The total uptime of all abatement systems for fab  $f$ , during the reporting year as calculated using equation I-23 to this section (expressed as a decimal fraction).

$a_{kif}$  = Estimate of fraction of fluorinated GHG by-product gas  $k$  emitted in fab  $f$  from tools using input gas  $i$  with abatement systems (expressed as a decimal fraction), as calculated using equation I-24D to this section.

$d_{kif}$  = Fraction of fluorinated GHG by-product  $k$  generated from input gas  $i$  destroyed or removed when fed into abatement systems by process tools in fab  $f$  that are included in the stack testing option, as calculated in equation I-24B to this section (expressed as decimal fraction).

$f$  = Fab.

$i$  = Fluorinated GHG input gas.

$k$  = Fluorinated GHG by-product.

- (vii) When using the stack testing method described in this paragraph (i), you must calculate abatement system uptime on a fab basis using equation I-23 to this section. When calculating abatement system uptime for use in equation I-19 and I-20 to this section, you must evaluate the variables "Td<sub>pf</sub>" and "UT<sub>pf</sub>" for the sampling period instead of the reporting year.

$$UT_f = 1 - \frac{\sum_p Td_{pf}}{\sum_p UT_{pf}} \quad (\text{Eq. I-23})$$

Where:



$UT_f$  = The average uptime factor for all abatement systems in fab  $f$  (expressed as a decimal fraction). The average uptime factor may be set to one (1) if all the abatement systems in fab  $f$  are interlocked with all the tools feeding the abatement systems such that no gas can flow to the tools if the abatement systems are not in operational mode.

$T_{dpf}$  = The total time, in minutes, that abatement system  $p$ , connected to process tool(s) in fab  $f$ , is not in operational mode as defined in § 98.98. If your fab uses redundant abatement systems, you may account for  $T_{dpf}$  as specified in § 98.94(f)(4)(vi).

$UT_{pf}$  = Total time, in minutes per year, in which the tool(s) connected at any point during the year to abatement system  $p$ , in fab  $f$  could be in operation. For determining the amount of tool operating time, you may assume that tools that were installed for the whole of the year were operated for 525,600 minutes per year. For tools that were installed or uninstalled during the year, you must prorate the operating time to account for the days in which the tool was not installed; treat any partial day that a tool was installed as a full day (1,440 minutes) of tool operation. For an abatement system that has more than one connected tool, the tool operating time is 525,600 minutes per year if there was at least one tool installed at all times throughout the year. If you have tools that are idle with no gas flow through the tool, you may calculate total tool time using the actual time that gas is flowing through the tool.

$f$  = Fab.

$p$  = Abatement system.

- (viii) When using the stack testing option described in this paragraph (i) and when using more than one DRE for the same input gas  $i$  or by-product gas  $k$ , you must calculate the weighted-average fraction of each fluorinated input gas  $i$  and each fluorinated by-product gas  $k$  that has more than one DRE and that is destroyed or removed in abatement systems for each fab  $f$ , as applicable, by using equation I-24A to this section (for input gases) and equation I-24B to this section (for by-product gases) and table I-18 to this subpart. If default values are not available in table I-18 for a particular input gas, you must use a value of 10.

$$D_{if} = \frac{\sum_p (\gamma_{i,p} \cdot \sum_{DRE_y} n_{i,p,DRE_y} \cdot DRE_y) + \sum_{DRE_z} DRE_z \cdot m_{i,q,DRE_z}}{\sum_p \gamma_{i,p} \cdot n_{i,p,a} + m_{i,q,a}} \quad (\text{Eq. I-24A})$$

$$D_{kif} = \frac{\sum_p (\gamma_{k,i,p} \cdot \sum_{DRE_y} n_{k,i,p,DRE_y} \cdot DRE_y) + \sum_{DRE_z} DRE_z \cdot m_{k,i,q,DRE_z}}{\sum_p \gamma_{k,i,p} \cdot n_{k,i,p,a} + m_{k,i,q,a}} \quad (\text{Eq. I-24B})$$

Where:

$d_{if}$  = The average weighted fraction of fluorinated GHG input gas  $i$  destroyed or removed when fed into abatement systems by process tools in fab  $f$  (expressed as a decimal fraction).

$d_{kif}$  = The average weighted fraction of fluorinated GHG by-product gas  $k$  generated from input gas  $i$  that is destroyed or removed when fed into abatement systems by process tools in fab  $f$  (expressed as a decimal fraction).

$n_{i,p,DREy}$  = Number of tools that use gas i, that run chamber cleaning process p, and that are equipped with abatement systems for gas i that have the DRE DREy.

$m_{i,q,DREz}$  = Number of tools that use gas i, that run etch and/or wafer cleaning processes, and that are equipped with abatement systems for gas i that have the DRE DREz.

$n_{i,p,a}$  = Total number of tools that use gas i, run chamber cleaning process type p, and that are equipped with abatement systems for gas i.

$m_{i,q,a}$  = Total number of tools that use gas i, run etch and/or wafer cleaning processes, and that are equipped with abatement systems for gas i.

$n_{k,i,p,DREy}$  = Number of tools that use gas i, generate by-product k, that run chamber cleaning process p, and that are equipped with abatement systems for gas i that have the DRE DREy.

$m_{k,i,q,DREz}$  = Number of tools that use gas i, generate by-product k, that run etch and/or wafer cleaning processes, and that are equipped with abatement systems for gas i that have the DRE DREz.

$n_{k,i,p,a}$  = Total number of tools that use gas i, generate by-product k, run chamber cleaning process type p, and that are equipped with abatement systems for gas i.

$m_{k,i,q,a}$  = Total number of tools that use gas i, generate by-product k, run etch and/or wafer cleaning processes, and that are equipped with abatement systems for gas i.

$\gamma_{i,p}$  = Default factor reflecting the ratio of uncontrolled emissions per tool of input gas i from tools running process sub-type p processes to uncontrolled emissions per tool of input gas i from process tools running process type q processes.

$\gamma_{k,i,p}$  = Default factor reflecting the ratio of uncontrolled emissions per tool of input gas i from tools running process sub-type p processes to uncontrolled emissions per tool of input gas i from process tools running process type q processes.

DRE<sub>y</sub> = Default or alternative certified DRE for gas i for abatement systems connected to CVD tool.

DRE<sub>z</sub> = Default or alternative certified DRE for gas i for abatement systems connected to etching and/or wafer cleaning tool.

p = Chamber cleaning process sub-type.

q = Reference process type. There is one process type q that consists of the combination of etching and/or wafer cleaning processes.

f = Fab.

i = Fluorinated GHG input gas.

(ix) When using the stack testing method described in this paragraph (i), you must calculate the fraction each fluorinated input gas  $i$  exhausted in fab  $f$  from tools with abatement systems and the fraction of each by-product gas  $k$  exhausted from tools with abatement systems, as applicable, by following either the procedure set forth in paragraph (i)(3)(ix)(A) of this section or the procedure set forth in paragraph (i)(3)(ix)(B) of this section.

(A) Use equation I-24C to this section (for input gases) and equation I-24D to this section (for by-product gases) and table I-18 to this subpart. If default values are not available in table I-18 for a particular input gas, you must use a value of 10.

$$A_{i,f} = \frac{\sum_p \gamma_{i,p} \cdot n_{i,p,a} + m_{i,q,a}}{\sum_p \gamma_{i,p} \cdot n_{i,p} + m_{i,q}} \quad (\text{Eq. I-24C})$$

Where:

$a_{i,f}$  = Fraction of fluorinated input gas  $i$  exhausted from tools with abatement systems in fab  $f$  (expressed as a decimal fraction).

$n_{i,p,a}$  = Number of tools that use gas  $i$ , that run chamber cleaning process sub-type  $p$ , and that are equipped with abatement systems for gas  $i$ .

$m_{i,q,a}$  = Number of tools that use gas  $i$ , that run etch and/or wafer cleaning processes, and that are equipped with abatement systems for gas  $i$ .

$n_{i,p}$  = Total number of tools using gas  $i$  and running chamber cleaning process sub-type  $p$ .

$m_{i,q}$  = Total number of tools using gas  $i$  and running etch and/or wafer cleaning processes.

$\gamma_{i,p}$  = Default factor reflecting the ratio of uncontrolled emissions per tool of input gas  $i$  from tools running process type  $p$  processes to uncontrolled emissions per tool of input gas  $i$  from process tools running process type  $q$  processes.

$p$  = Chamber cleaning process sub-type.

$q$  = Reference process type. There is one process type  $q$  that consists of the combination of etching and/or wafer cleaning processes.

$$A_{k,i,f} = \frac{\sum_p \gamma_{k,i,p} \cdot n_{k,i,p,a} + m_{k,i,q,a}}{\sum_p \gamma_{k,i,p} \cdot n_{k,i,p} + m_{k,i,q}} \quad \text{Eq. I-24D}$$

Where:

$a_{k,i,f}$  = Fraction of by-product gas  $k$  exhausted from tools using input gas  $i$  with abatement systems in fab  $f$  (expressed as a decimal fraction).

$n_{k,i,p,a}$  = Number of tools that exhaust by-product gas  $k$  from input gas  $i$ , that run chamber cleaning process  $p$ , and that are equipped with abatement systems for gas  $k$ .

$m_{k,i,q,a}$  = Number of tools that exhaust by-product gas k from input gas i, that run etch and/or wafer cleaning processes, and that are equipped with abatement systems for gas k.

$n_{k,i,p}$  = Total number of tools emitting by-product k from input gas i and running chamber cleaning process p.

$m_{k,i,q}$  = Total number of tools emitting by-product k from input gas i and running etch and/or wafer cleaning processes.

$\gamma_{k,i,p}$  = Default factor reflecting the ratio of uncontrolled emissions per tool of by-product gas k from input gas i from tools running chamber cleaning process p to uncontrolled emissions per tool of by-product gas k from input gas i from process tools running etch and/or wafer cleaning processes.

p = Chamber cleaning process sub-type.

q = Reference process type. There is one process type q that consists of the combination of etching and/or wafer cleaning processes.

(B) Use paragraph (e) of this section to apportion consumption of gas i either to tools with abatement systems and tools without abatement systems or to each process type or sub-type, as applicable. If you apportion consumption of gas i to each process type or sub-type, calculate the fractions of input gas i and by-product gas k formed from gas i that are exhausted from tools with abatement systems based on the numbers of tools with and without abatement systems within each process type or sub-type.

(4) **Method to calculate emissions from fluorinated GHGs that are not tested.** Calculate emissions from consumption of each intermittent low-use fluorinated GHG as defined in § 98.98 of this subpart using the default utilization and by-product formation rates provided in table I-11, I-12, I-13, I-14, or I-15 to this subpart, as applicable, and by using equations I-8A, I-8B, I-9, and I-13 to this section. If a fluorinated GHG was not being used during the stack testing and does not meet the definition of intermittent low-use fluorinated GHG in § 98.98, then you must test the stack systems associated with the use of that fluorinated GHG at a time when that gas is in use at a magnitude that would allow you to determine an emission factor for that gas according to the procedures specified in paragraph (i)(3) of this section.

(5) [Reserved]

[75 FR 74818, Dec. 1, 2010, as amended at 76 FR 59551, Sept. 27, 2011; 77 FR 10380, Feb. 22, 2012; 78 FR 68202, Nov. 13, 2013; 79 FR 25682, May 6, 2014; 79 FR 73783, Dec. 11, 2014; 79 FR 77391, Dec. 24, 2014; 81 FR 89253, Dec. 9, 2016; 89 FR 31907, Apr. 25, 2024]

## § 98.94 Monitoring and QA/QC requirements.

(a) [Reserved]

(b) For purposes of Equation I-12 of this subpart, you must estimate fab-wide gas-specific heel factors for each container type for each gas used, according to the procedures in paragraphs (b)(1) through (b)(5) of this section. This paragraph (b) does not apply to fluorinated GHGs or N<sub>2</sub>O that your fab uses in quantities

of less than 50 kg in one reporting year and for which you calculate emissions as equal to consumption under § 98.93(a)(1), (a)(2), or (b), or for any intermittent low-use fluorinated GHG for which you calculate emissions according to § 98.93(i)(4)(i).

- (1) Base your fab-wide gas-specific heel factors on the trigger point for change out of a container for each container size and type for each gas used. Fab-wide gas-specific heel factors must be expressed as the ratio of the trigger point for change out, in terms of mass, to the initial mass in the container, as determined by paragraphs (b)(2) and (3) of this section.
- (2) The trigger points for change out you use to calculate fab-wide gas-specific heel factors in paragraph (b)(1) of this section must be determined by monitoring the mass or the pressure of your containers. If you monitor the pressure, convert the pressure to mass using the ideal gas law, as displayed in Equation I-25 of this subpart, with the appropriate Z value selected based upon the properties of the gas.

$$pV = ZnRT \quad (\text{Eq. I-25})$$

Where:

p = Absolute pressure of the gas (Pa).

V = Volume of the gas container (m<sup>3</sup>).

Z = Compressibility factor.

n = Amount of substance of the gas (moles).

R = Gas constant (8.314 Joule/Kelvin mole).

T = Absolute temperature (K).

- (3) The initial mass you use to calculate a fab-wide gas-specific heel factor in paragraph (b)(1) of this section may be based on the weight of the gas provided to you in gas supplier documents; however, you remain responsible for the accuracy of these masses and weights under this subpart.
- (4) If a container is changed in an exceptional circumstance, as specified in paragraphs (b)(4)(i) and (ii) of this section, you must weigh that container or measure the pressure of that container with a pressure gauge, in place of using a heel factor to determine the residual weight of gas. When using mass-based trigger points for change out, you must determine if an exceptional circumstance has occurred based on the net weight of gas in the container, excluding the tare weight of the container.
  - (i) For containers with a maximum storage capacity of less than 9.08 kg (20 lbs) of gas, an exceptional circumstance is a change out point that differs by more than 50 percent from the trigger point for change out used to calculate your fab-wide gas-specific heel factor for that gas and container type.
  - (ii) For all other containers, an exceptional circumstance is a change out point that differs by more than 20 percent from the trigger point for change out used to calculate your fab-wide gas-specific heel factor for that gas and container type.

(5) You must re-calculate a fab-wide gas-specific heel factor if you execute a process change to modify the trigger point for change out for a gas and container type that differs by more than 5 percent from the previously used trigger point for change out for that gas and container type.

(c) You must develop apportioning factors for fluorinated GHG and N<sub>2</sub>O consumption (including the fraction of gas consumed by process tools connected to abatement systems as in equations I-8A, I-8B, I-9, and I-10 to § 98.93), to use in the equations of this subpart for each input gas *i*, process sub-type, process type, stack system, and fab as appropriate, using a fab-specific engineering model that is documented in your site GHG Monitoring Plan as required under § 98.3(g)(5). This model must be based on a quantifiable metric, such as wafer passes or wafer starts, or direct measurement of input gas consumption as specified in paragraph (c)(3) of this section. To verify your model, you must demonstrate its precision and accuracy by adhering to the requirements in paragraphs (c)(1) and (2) of this section.

(1) You must demonstrate that the fluorinated GHG and N<sub>2</sub>O apportioning factors are developed using calculations that are repeatable, as defined in § 98.98.

(2) You must demonstrate the accuracy of your fab-specific model by comparing the actual amount of input gas *i* consumed and the modeled amount of input gas *i* consumed in the fab, as follows:

(i) You must analyze actual and modeled gas consumption for a period when the fab is at a representative operating level (as defined in § 98.98) lasting at least 30 days but no more than the reporting year.

(ii) You must compare the actual gas consumed to the modeled gas consumed for one fluorinated GHG reported under this subpart for the fab. You must certify that the fluorinated GHG selected for comparison corresponds to the largest quantity, on a mass basis, of fluorinated GHG consumed at the fab during the reporting year for which you are required to apportion following the procedures specified in § 98.93(a), (b), or (i). You may compare the actual gas consumed to the modeled gas consumed for two fluorinated GHGs and demonstrate conformance according to paragraph (c)(2)(iii) of this section on an aggregate use basis for both fluorinated GHGs if one of the fluorinated GHGs selected for comparison corresponds to the largest quantity, on a mass basis, of fluorinated GHGs used at each fab that requires apportionment during the reporting year.

(iii) You must demonstrate that the comparison performed for the largest quantity of gas(es), on a mass basis, consumed in the fab in paragraph (c)(2)(ii) of this section, does not result in a difference between the actual and modeled gas consumption that exceeds 20 percent relative to actual gas consumption, reported to two significant figures using standard rounding conventions.

(iv) If you are required to apportion gas consumption and you use the procedures in § 98.93(i) to calculate annual emissions from a fab, you must verify your apportioning factors using the procedures in paragraphs (c)(2)(ii) and (iii) of this section such that the time period specified in paragraph (c)(2)(i) of this section and the last day you perform the sampling events specified under § 98.93(i)(3) occur in the same accounting month.

(v) If your facility has multiple fabs with a single centralized fluorinated-GHG supply system, you must verify that your apportioning model can apportion fluorinated GHG consumption among the fabs by adhering to the procedures in paragraphs (c)(2)(ii) through (c)(2)(iv) of this section.

- (3) As an alternative to developing apportioning factors for fluorinated GHG and N<sub>2</sub>O consumption using a fab-specific engineering model, you may develop apportioning factors through the use of direct measurement using gas flow meters and weigh scales to measure process sub-type, process type, stack system, or fab-specific input gas consumption. You may use a combination of apportioning factors developed using a fab-specific engineering model and apportioning factors developed through the use of direct measurement, provided this is documented in your site GHG Monitoring Plan as required under 98.3(g)(5).
- (d) [Reserved]
- (e) If you use HC fuel CECS purchased and installed on or after January 1, 2025 to control emissions from tools that use either NF<sub>3</sub> as an input gas in remote plasma cleaning processes or F<sub>2</sub> as an input gas in any process, and if you use a value less than 1 for either  $a_{F_2,j}$  or  $a_{NF_3,RPC}$  in equation I-9 to § 98.93, you must certify and document that the model for each of the systems for which you are claiming that it does not form CF<sub>4</sub> from F<sub>2</sub> has been tested and verified to produce less than 0.1% CF<sub>4</sub> from F<sub>2</sub> and that each of the systems is installed, operated, and maintained in accordance with the directions of the HC fuel CECS manufacturer. Hydrocarbon-fuel-based combustion emissions control systems include but are not limited to abatement systems as defined in § 98.98 that are hydrocarbon-fuel-based. The rate of conversion from F<sub>2</sub> to CF<sub>4</sub> must be measured using a scientifically sound, industry-accepted method that accounts for dilution through the abatement device, such as EPA 430-R-10-003 (incorporated by reference, see § 98.7), adjusted to calculate the rate of conversion from F<sub>2</sub> to CF<sub>4</sub> rather than the DRE. Either the HC fuel CECS manufacturer or the electronics manufacturer may perform the measurement. The flow rate of F<sub>2</sub> into the tested HC fuel CECS may be metered using a calibrated mass flow controller.
- (f) If your fab employs abatement systems and you elect to reflect emission reductions due to these systems, or if your fab employs abatement systems designed for fluorinated GHG abatement and you elect to calculate fluorinated GHG emissions using the stack test method under § 98.93(i), you must comply with the requirements of paragraphs (f)(1) through (3) of this section. If you use an average of properly measured destruction or removal efficiencies for a gas and process sub-type or process type combination, as applicable, in your emission calculations under § 98.93(a), (b), and/or (i), you must also adhere to procedures in paragraph (f)(4) of this section.
- (1) You must certify and document that the abatement systems are properly installed, operated, and maintained according to the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9).
- (2) You must calculate and document the uptime of abatement systems using Equation I-15 or I-23 of this subpart, as applicable.
- (3) If you use default destruction and removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i), you must certify and document that the abatement systems at your facility for which you use default destruction or removal efficiency values are specifically designed for fluorinated GHG or N<sub>2</sub>O abatement, as applicable, and provide the abatement system manufacturer-verified DRE value that meets (or exceeds) the default destruction or removal efficiency in table I-16 to this subpart for the fluorinated GHG or N<sub>2</sub>O. For abatement systems purchased and installed on or after January 1, 2025, you must also certify and document that the abatement system has been tested by the abatement system manufacturer based on the methods specified in paragraph (f)(3)(i) of this section and verified to meet (or exceed) the default destruction or removal efficiency in table I-16 for the fluorinated GHG or N<sub>2</sub>O under worst-case flow conditions as defined in paragraph (f)(3)(ii) of this section. If you use a verified destruction and removal efficiency value that is lower than the default in table I-16 to this subpart in your emissions calculations under § 98.93(a), (b),

and/or (i), you must certify and document that the abatement systems at your facility for which you use the verified destruction or removal efficiency values are specifically designed for fluorinated GHG or N<sub>2</sub>O abatement, as applicable, and provide the abatement system manufacturer-verified DRE value that is lower than the default destruction or removal efficiency in table I-16 for the fluorinated GHG or N<sub>2</sub>O. For abatement systems purchased and installed on or after January 1, 2025, you must also certify and document that the abatement system has been tested by the abatement system manufacturer based on the methods specified in paragraph (f)(3)(i) of this section and verified to meet or exceed the destruction or removal efficiency value used for that fluorinated GHG or N<sub>2</sub>O under worst-case flow conditions as defined in paragraph (f)(3)(ii) of this section. If you elect to calculate fluorinated GHG emissions using the stack test method under § 98.93(i), you must also certify that you have included and accounted for all abatement systems designed for fluorinated GHG abatement and any respective downtime in your emissions calculations under § 98.93(i)(3).

- (i) For purposes of paragraph (f)(3) of this section, destruction and removal efficiencies for abatement systems purchased and installed on or after January 1, 2025, must be measured using a scientifically sound, industry-accepted measurement methodology that accounts for dilution through the abatement system, such as EPA 430-R-10-003 (incorporated by reference, see § 98.7).
  - (ii) Worst-case flow conditions are defined as the highest total fluorinated GHG or N<sub>2</sub>O flows through each model of emissions control systems (gas by gas and process type by process type across the facility) and the highest total flow scenarios (with N<sub>2</sub> dilution accounted for) across the facility during which the abatement system is claimed to be in operational mode.
- (4) If you calculate and report controlled emissions using neither the default destruction or removal efficiency values in table I-16 to this subpart nor an abatement system manufacturer-verified lower destruction or removal efficiency value per paragraph (f)(3) of this section, you must use an average of properly measured destruction or removal efficiencies for each gas and process sub-type or process type combination, as applicable, determined in accordance with procedures in paragraphs (f)(4)(i) through (vi) of this section. This includes situations in which your fab employs abatement systems not specifically designed for fluorinated GHG or N<sub>2</sub>O abatement or for which your fab operates abatement systems outside the range of parameters specified in the documentation supporting the certified DRE and you elect to reflect emission reductions due to these systems. You must not use a default value from table I-16 to this subpart for any abatement system not specifically designed for fluorinated GHG and N<sub>2</sub>O abatement, for any abatement system not certified to meet the default value from table I-16, or for any gas and process type combination for which you have measured the destruction or removal efficiency according to the requirements of paragraphs (f)(4)(i) through (vi) of this section.
- (i) A properly measured destruction or removal efficiency value must be determined in accordance with EPA 430-R-10-003 (incorporated by reference, see § 98.7), or according to an alternative method approved by the Administrator (or authorized representative) as specified in paragraph (k) of this section. If you are measuring destruction or removal efficiency according to EPA 430-R-10-003 (incorporated by reference, see § 98.7), you may follow the alternative procedures specified in Appendix A to this subpart.
  - (ii) You must select and properly measure the destruction or removal efficiency for a random sample of abatement systems to include in a random sampling abatement system testing program in accordance with procedures in paragraphs (f)(4)(ii)(A) and (B) of this section.



- (A) For the first 2 years for which your fab is required to report emissions of fluorinated GHG and N<sub>2</sub>O, for each abatement system gas and process sub-type or process type combination, as applicable, a random sample of a minimum of 10 percent of installed abatement systems must be tested annually for a total of a minimum of 20 percent, or a minimum of 20 percent may be tested in the first year. For every 3-year period following the initial 2-year period, a random sample of at least 15 percent of installed abatement systems must be tested for each gas and process sub-type or process type combination; you may test 15-percent in the first year of the 3-year period, but you must test at least 5 percent each year until 15 percent are tested. For each 3-year period, you must determine the number of abatement systems to be tested based on the average number of abatement systems in service over the 3-year period. If the required percent of the total number of abatement systems to be tested for each gas and process sub-type or process type combination does not equate to a whole number, the number of systems to be tested must be determined by rounding up to the nearest integer. Except as provided in paragraph (f)(4)(v) of this section, you may not retest an abatement system for any gas and process sub-type or process type combination, as applicable, until all of the abatement systems for that gas and process sub-type or process type combination have been tested.
- (B) If testing of a randomly selected abatement system would be disruptive to production, you may replace that system with another randomly selected system for testing and return the system to the sampling pool for subsequent testing. Any one abatement system must not be replaced by another randomly selected system for more than three consecutive selections. When you have to replace a system in one year, you may select that specific system to be tested in one of the next two sampling years so that you may plan testing of that abatement system to avoid disrupting production.
- (iii) If you elect to take credit for abatement system destruction or removal efficiency before completing testing on 20 percent of the abatement systems for that gas and process sub-type or process type combination, as applicable, you must use default destruction or removal efficiencies or a verified destruction or removal efficiency, if verified at a lower value, for a gas and process type combination. You must not use a default value from table I-16 to this subpart for any abatement system not specifically designed for fluorinated GHG and N<sub>2</sub>O abatement, and must not take credit for abatement system destruction or removal efficiency before completing testing on 20 percent of the abatement systems for that gas and process sub-type or process type combination, as applicable. Following testing on 20 percent of abatement systems for that gas and process sub-type or process type combination, you must calculate the average destruction or removal efficiency as the arithmetic mean of all test results for that gas and process sub-type or process type combination, until you have tested at least 30 percent of all abatement systems for each gas and process sub-type or process type combination. After testing at least 30 percent of all systems for a gas and process sub-type or process type combination, you must use the arithmetic mean of the most recent 30 percent of systems tested as the average destruction or removal efficiency. You may include results of testing conducted on or after January 1, 2011 for use in determining the site-specific destruction or removal efficiency for a given gas and process sub-type or process type combination if the testing was conducted in accordance with the requirements of paragraph (f)(4)(i) of this section.

- (iv) If a measured destruction or removal efficiency is below the manufacturer-claimed fluorinated GHG or N<sub>2</sub>O destruction or removal efficiency for any abatement system specifically designed for fluorinated GHG or N<sub>2</sub>O abatement and the abatement system is installed, operated, and maintained in accordance with the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9), the measured destruction or removal efficiency must be included in the calculation of the destruction or removal efficiency value for that gas and process sub-type or process type.
  - (v) If a measured destruction or removal efficiency is below the manufacturer-claimed fluorinated GHG or N<sub>2</sub>O destruction or removal efficiency for any abatement system specifically designed for fluorinated GHG or N<sub>2</sub>O abatement and the abatement system is not installed, operated, or maintained in accordance with the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9), you must implement corrective action and perform a retest to replace the measured value within the reporting year. In lieu of retesting within the reporting year, you may use the measured value in calculating the average destruction or removal efficiency for the reporting year, implement corrective action, and then include the same system in the next abatement system testing period in addition to the testing of randomly selected systems for that next testing period. Regardless of whether you use the lower measured destruction or removal efficiency and when you perform the retest of the abatement system, you must count the time that the abatement system is not operated and maintained according to the site maintenance plan for abatement systems as not being in operational mode for purposes of calculating abatement system uptime.
  - (vi) If your fab uses redundant abatement systems, you may account for the total abatement system uptime (that is, the time that at least one abatement system is in operational mode) calculated for a specific exhaust stream during the reporting year.
- (g) You must adhere to the QA/QC procedures of this paragraph when calculating fluorinated GHG and N<sub>2</sub>O emissions from electronics manufacturing production processes:
- (1)-(2) [Reserved]
  - (3) Follow the QA/QC procedures in accordance with those in EPA 430-R-10-003 (incorporated by reference, see § 98.7), or the applicable QA/QC procedures specified in an alternative method approved by the Administrator (or authorized representative) according to paragraph (k) of this section, when calculating abatement systems destruction or removal efficiencies. If you are measuring destruction or removal efficiency according to EPA 430-R-10-003 (incorporated by reference, see § 98.7), and you elect to follow the alternative procedures specified in Appendix A to this subpart according to paragraph (f)(4)(i) of this section, you must follow any additional QA/QC procedures specified in Appendix A to this subpart.
  - (4) As part of normal operations for each fab, the inventory of gas stored in containers at the beginning of the reporting year must be the same as the inventory of gas stored in containers at the end of the previous reporting year. You must maintain records documenting the year end and year beginning inventories under § 98.97(a).
- (h) You must adhere to the QA/QC procedures of this paragraph (h) when calculating annual gas consumption for each fluorinated GHG and N<sub>2</sub>O used at each fab and emissions from the use of each fluorinated heat transfer fluid on a fab basis.
- (1) Review all inputs to Equations I-11 and I-16 of this subpart to ensure that all inputs and outputs are accounted for.

- (2) Do not enter negative inputs into the mass balance Equations I-11 and I-16 of this subpart and ensure that no negative emissions are calculated.
  - (3) Ensure that the inventory at the beginning of one reporting year is identical to the inventory at the end of the previous reporting year. You must maintain records documenting the year end and year beginning inventories under § 98.97(a) and (r).
  - (4) Ensure that the total quantity of gas *i* in containers in service at the end of a reporting year is accounted for as if the in-service containers were full for Equation I-11 of this subpart. Ensure also that the same quantity is accounted for in the inventory of input gas *i* stored in containers at the beginning of the subsequent reporting year.
- (i) All flow meters, weigh scales, pressure gauges, and thermometers used to measure quantities that are monitored under this section or used in calculations under § 98.93 must meet the calibration and accuracy requirements specified in § 98.3(i).
- (j) **Stack test methodology.** For each fab for which you calculate annual emissions for any fluorinated GHG emitted from your facility using the stack test method according to the procedure specified in § 98.93(i)(3), you must adhere to the requirements in paragraphs (j)(1) through (8) of this section. You may request approval to use an alternative stack test method and procedure according to paragraph (k) of this section.
- (1) **Stack system testing.** Conduct an emissions test for each stack system according to the procedures in paragraphs (j)(1)(i) through (iv) of this section.
- (i) You must conduct an emission test during which the fab is operating at a representative operating level, as defined in § 98.98, and with the abatement systems connected to the stack system being tested operating with at least 90-percent uptime, averaged over all abatement systems, during the 8-hour (or longer) period for each stack system, or at no less than 90 percent of the abatement system uptime rate measured over the previous reporting year, averaged over all abatement systems. Hydrocarbon-fuel-based combustion emissions control systems that were purchased and installed on or after January 1, 2025, that are used to control emissions from tools that use either NF<sub>3</sub> in remote plasma cleaning processes or F<sub>2</sub> as an input gas in any process type or sub-type, and that are not certified not to form CF<sub>4</sub>, must operate with at least 90-percent uptime during the test.
  - (ii) You must measure for the expected and possible by-products identified in Table I-17 of this subpart and those fluorinated GHGs used as input fluorinated GHG in process tools vented to the stack system, except for any intermittent low-use fluorinated GHG as defined in § 98.98. You must calculate annual emissions of intermittent low-use fluorinated GHGs by adhering to the procedures in § 98.93(i)(4)(i).
  - (iii) If a fluorinated GHG being consumed in the reporting year was not being consumed during the stack testing and does not meet the definition of intermittent low-use fluorinated GHG in § 98.98, then you must test the stack systems associated with the use of that fluorinated GHG at a time when that gas is in use at a magnitude that would allow you to determine an emission factor for that gas. If a fluorinated GHG consumed in the reporting year was not being consumed during the stack testing and is no longer in use by your fab (e.g., use of the gas has become obsolete or has been discontinued), then you must calculate annual emissions for that fluorinated GHG according to the procedure specified in § 98.93(i)(4).

- (iv) Although all applicable stack systems are not required to be tested simultaneously, you must certify that no significant changes in stack flow configuration occur between tests conducted for any particular fab in a reporting year. You must certify that no more than 10 percent of the total number of fluorinated GHG emitting process tools are connected or disconnected from a stack system during testing. You must also certify that no process tools that were in operation at the start of the test period have been moved to a different stack system during the test period (i.e., during or in between testing of individual stack systems) and that no point-of-use abatement systems have been permanently removed from service during the test period. You must document any changes in stack flow configuration in the emissions test data and report required to be kept as records under § 98.97(i)(4).
- (2) **Test methods and procedures.** You must adhere to the applicable test methods and procedures specified in Table I-9 to this subpart, or adhere to an alternative method approved by the Administrator (or authorized representative) according to paragraph (k) of this section. If you select Method 320 of 40 CFR part 63, Appendix A to measure the concentration of each fluorinated GHG in the stack system, you must complete a method validation according to Section 13 of Method 320 of 40 CFR part 63, Appendix A for each FTIR system (hardware and software) and each tester (testing company). Method 320 validation is necessary when any change occurs in instrumentation, tester (i.e., testing company), or stack condition (e.g., acid gas vs. base). Measurement of new compounds require validation for those compounds according to Section 13 of Method 320 of 40 CFR part 63, Appendix A. The field detection limits achieved under your test methods and procedures must fall at or below the maximum field detection limits specified in Table I-10 to this subpart.
- (3) **Fab-specific fluorinated GHG consumption measurements.** You must determine the amount of each fluorinated GHG consumed by each fab during the sampling period for all process tools connected to the stack systems under § 98.93(i)(3), according to the procedures in paragraphs (j)(3)(i) and (ii) of this section.
  - (i) Measure fluorinated GHG consumption using gas flow meters, scales, or pressure measurements. Measure the mass or pressure, as applicable, at the beginning and end of the sampling period and when containers are changed out. If you elect to measure gas consumption using pressure (i.e., because the gas is stored in a location above its critical temperature) you must estimate consumption as specified in paragraphs (j)(3)(i)(A) and (B) of this section.
    - (A) For each fluorinated GHG, you must either measure the temperature of the fluorinated GHG container(s) when the sampling periods begin and end and when containers are changed out, or measure the temperature of the fluorinated GHG container(s) every hour for the duration of the sampling period. Temperature measurements of the immediate vicinity of the containers (e.g., in the same room, near the containers) shall be considered temperature measurements of the containers.
    - (B) Convert the sampling period-beginning, sampling period-ending, and container change-out pressures to masses using Equation I-25 of this subpart, with the appropriate Z value selected based upon the properties of the gas (e.g., the Z value yielded by the Redlich, Kwong, Soave equation of state with appropriate values for that gas). Apply the temperatures measured at or nearest to the beginning and end of the sampling period and to the time(s) when containers are changed out, as applicable. For each gas, the

consumption during the sampling period is the difference between the masses of the containers of that gas at the beginning and at the end of the sampling period, summed across containers, including containers that are changed out.

- (ii) For each fluorinated GHG gas for which consumption is too low to be accurately measured during the sampling period using gas flow meters, scales, or pressure measurements as specified in paragraph (j)(3)(i) of this section, you must follow at least one of the procedures listed in paragraph (j)(3)(ii)(A) through (C) of this section to obtain a consumption measurement.
  - (A) Draw the gas from a single gas container if it is normally supplied from multiple containers connected by a shared manifold.
  - (B) Calculate consumption from pro-rated long-term consumption data (for example, calculate and use hourly consumption rates from monthly consumption data).
  - (C) Increase the duration of the sampling period for consumption measurement beyond the minimum duration specified in Table I-9 of this subpart.
- (4) **Emission test results.** The results of an emission test must include the analysis of samples, number of test runs, the average emission factor for each fluorinated GHG measured, the analytical method used, calculation of emissions, the fluorinated GHGs consumed during the sampling period, an identification of the stack systems tested, and the fluorinated GHGs that were included in the test. The emissions test report must contain all information and data used to derive the fab-specific emission factor.
- (5) **Emissions testing frequency.** You must conduct emissions testing to develop fab-specific emission factors on a frequency according to the procedures in paragraph (j)(5)(i) or (ii) of this section.
  - (i) **Annual testing.** You must conduct an annual emissions test for each stack system unless you meet the criteria in paragraph (j)(5)(ii) of this section to skip annual testing. Each set of emissions testing for a stack system must be separated by a period of at least 2 months.
  - (ii) **Criteria to test less frequently.** After the first 3 years of annual testing, you may calculate the relative standard deviation of the emission factors for each fluorinated GHG included in the test and use that analysis to determine the frequency of any future testing. As an alternative, you may conduct all three tests in less than 3 calendar years for purposes of this paragraph (j)(5)(ii), but this does not relieve you of the obligation to conduct subsequent annual testing if you do not meet the criteria to test less frequently. If the criteria specified in paragraphs (j)(5)(ii)(A) and (B) of this section are met, you may use the arithmetic average of the three emission factors for each fluorinated GHG and fluorinated GHG byproduct for the current year and the next 4 years with no further testing unless your fab operations are changed in a way that triggers the re-test criteria in paragraph (j)(8) of this section. In the fifth year following the last stack test included in the previous average, you must test each of the stack systems and repeat the relative standard deviation analysis using the results of the most recent three tests (i.e., the new test and the two previous tests conducted prior to the 4-year period). If the criteria specified in paragraphs (j)(5)(ii)(A) and (B) of this section are not met, you must use the emission factors developed from the most recent testing and continue annual testing. You may conduct more than one test in the same year, but each set of emissions testing for a stack system must be separated by a period of at least 2 months. You may repeat the relative standard deviation analysis using the most recent three tests, including those tests conducted prior to the 4-year period, to determine if you are exempt from testing for the next 4 years.

- (A) The relative standard deviation of the total CO<sub>2</sub>e emission factors calculated from each of the three tests (expressed as the total CO<sub>2</sub>e fluorinated GHG emissions of the fab divided by the total CO<sub>2</sub>e fluorinated GHG use of the fab) is less than or equal to 15 percent.
  - (B) The relative standard deviation for all single fluorinated GHGs that individually accounted for 5 percent or more of CO<sub>2</sub>e emissions were less than 20 percent.
- (6) [Reserved]
- (7) **Previous measurements.** You may include the results of emissions testing conducted on or after January 1, 2011 for use in the relative standard deviation calculation in paragraph (j)(5)(ii) of this section if the previous results were determined using a method meeting the requirements in paragraph (j)(2) of this section. You may request approval to use results of emissions testing conducted between January 1, 2011 and January 1, 2014 using a method that deviated from the requirements in paragraph (j)(2) of this section by adhering to the requirements in paragraphs (j)(7)(i) through (j)(7)(iv) of this section.
  - (i) Notify the Administrator (or an authorized representative) of your intention to use the results of the previous emissions testing. You must include in the notification the data and results you intend to use for meeting either reporting or recordkeeping requirements, a description of the method, and any deviations from the requirements in paragraph (j)(2) of this section. Your description must include an explanation of how any deviations do not affect the quality of the data collected.
  - (ii) The Administrator will review the information submitted under paragraph (j)(7)(i) and determine whether the results of the previous emissions testing are adequate and issue an approval or disapproval of the use of the results within 120 days of the date on which you submit the notification specified in paragraph (j)(7)(i) of this section.
  - (iii) If the Administrator finds reasonable grounds to disapprove the results of the previous emissions testing, the Administrator may request that you provide additional information to support the use of the results of the previous emissions testing. Failure to respond to any request made by the Administrator does not affect the 120 day deadline specified in paragraph (j)(7)(ii) of this section.
  - (iv) Neither the approval process nor the failure to obtain approval for the use of results from previous emissions testing shall abrogate your responsibility to comply with the requirements of this subpart.
- (8) **Scenarios that require a stack system to be re-tested.** By March 31 of each reporting year, you must evaluate and determine whether any changes to your fab operations meet the criteria specified in paragraphs (j)(8)(i) through (vi) of this section. If any of the scenarios specified in paragraph (j)(8)(i) through (vi) of this section occur, you must perform a re-test of any applicable stack system, irrespective of whether you have met the criteria for less frequent testing in paragraph (j)(5)(ii) of this section, before the end of the year in which the evaluation was completed. You must adhere to the methods and procedures specified in § 98.93(i)(3) for performing a stack system emissions test and calculating emissions. If you meet the criteria for less frequent testing in paragraph (j)(5)(ii), and you are required to perform a re-test as specified in paragraph (j)(8)(i) through (vi) of this section, the requirement to perform a re-test does not extend the date of the next scheduled test that was established prior to meeting the requirement to perform a re-test. If the criteria specified in paragraph (j)(5)(ii) of this section are not met using the results from the re-test and the two most recent stack tests, you must use the emission factors developed from the most recent testing to

calculate emissions and resume annual testing. You may resume testing less frequently according to your original schedule if the criteria specified in paragraph (j)(5)(ii) of this section are met using the most recent three tests.

- (i) Annual consumption of a fluorinated GHG used during the most recent emissions test (expressed in CO<sub>2</sub>e) changes by more than 10 percent of the total annual fluorinated GHG consumption, relative to gas consumption in CO<sub>2</sub>e for that gas during the year of the most recent emissions test (for example, if the use of a single gas goes from 25 percent of CO<sub>2</sub>e to greater than 35 percent of CO<sub>2</sub>e, this change would trigger a re-test).
- (ii) A change in the consumption of an intermittent low-use fluorinated GHG (as defined in § 98.98) that was not used during the emissions test and not reflected in the fab-specific emission factor, such that it no longer meets the definition of an intermittent low-use fluorinated GHG.
- (iii) A decrease by more than 10 percent in the fraction of tools with abatement systems, compared to the number during the most recent emissions test.
- (iv) A change in the wafer size manufactured by the fab since the most recent emissions test.
- (v) [Reserved]
- (vi) If a fluorinated GHG being consumed in the reporting year was not being consumed during the stack test and does not meet the definition of intermittent, low-use fluorinated GHG in § 98.98, then you must test the stack systems associated with the use of that fluorinated GHG at a time when that gas is in use as required in paragraph (j)(1)(iii) of this section.

(k) You may request approval to use an alternative stack test method and procedure or to use an alternative method to determine abatement system destruction or removal efficiency by adhering to the requirements in paragraphs (k)(1) through (6) of this section. An alternative method is any method of sampling and analyzing for a fluorinated GHG or N<sub>2</sub>O, or the determination of parameters other than concentration, for example, flow measurements, that is not a method specified in this subpart and that has been demonstrated to the Administrator's satisfaction, using Method 301 in appendix A of part 63, to produce results adequate for the Administrator's determination that it may be used in place of a method specified elsewhere in this subpart.

(1) You may use an alternative method from that specified in this subpart provided that you:

- (i) Notify the Administrator (or an authorized representative) of your intention to use an alternative method. You must include in the notification a site-specific test plan describing the alternative method and procedures (the alternative test plan), the range of test conditions over which the validation is intended to be applicable, and an alternative means of calculating the fab-level fluorinated GHG or N<sub>2</sub>O emissions or determining the abatement system destruction or removal efficiency if the Administrator denies the use of the results of the alternative method under paragraph (k)(2) or (3) of this section.
- (ii) Use Method 301 in appendix A of part 63 of this chapter to validate the alternative method. This may include the use of only portions of specific procedures of Method 301 if use of such procedures are sufficient to validate the alternative method; and
- (iii) Submit the results of the Method 301 validation process along with the notification of intention and the rationale for not using the specified method.

- (2) The Administrator will determine whether the validation of the proposed alternative method is adequate and issue an approval or disapproval of the alternative test plan within 120 days of the date on which you submit the notification and alternative test plan specified in paragraph (k)(1) of this section. If the Administrator approves the alternative test plan, you are authorized to use the alternative method(s) in place of the methods described in paragraph (f)(4)(i) of this section for measuring destruction or removal efficiency or paragraph (j) of this section for conducting the stack test, as applicable, taking into account the Administrator's comments on the alternative test plan. Notwithstanding the requirement in the preceding sentence, you may at any time prior to the Administrator's approval or disapproval proceed to conduct the stack test using the methods specified in paragraph (j) of this section or the destruction or removal efficiency determination specified in (f)(4)(i) of this section if you use a method specified in this subpart instead of the requested alternative. If an alternative test plan is not approved and you still want to use an alternative method, you must recommence the process to have an alternative test method approved starting with the notification of intent to use an alternative test method specified in paragraph (k)(1)(i) of this section.
- (3) You must report the results of stack testing or destruction or removal efficiency determination using the alternative method and procedure specified in the approved alternative test plan. You must include in your report for an alternative stack test method and for an alternative abatement system destruction or removal efficiency determination the information specified in paragraph (j)(4) of this section, including all methods, calculations and data used to determine the fluorinated GHG emission factor or the abatement system destruction or removal efficiency. The Administrator will review the results of the test using the alternative methods and procedure and then approve or deny the use of the results of the alternative test method and procedure no later than 120 days after they are submitted to EPA.
- (4) If the Administrator finds reasonable grounds to dispute the results obtained by an alternative method for the purposes of determining fluorinated GHG emissions or destruction or removal efficiency of an abatement system, the Administrator may require the use of another method specified in this subpart.
- (5) Once the Administrator has approved the use of the alternative method for the purposes of determining fluorinated GHG emissions for specific fluorinated GHGs and types of stack systems or abatement system destruction or removal efficiency, that method may be used at any other facility for the same fluorinated GHGs and types of stack systems, or fluorinated GHGs and abatement systems, if the approved conditions apply to that facility. In granting approval, the Administrator may limit the range of test conditions and emission characteristics for which that approval is granted and under which the alternative method may be used without seeking approval under paragraphs (k)(1) through (4) of this section. The Administrator will specify those limitations, if any, in the approval of the alternative method.
- (6) Neither the validation and approval process nor the failure to validate or obtain approval of an alternative method shall abrogate your responsibility to comply with the requirements of this subpart.

[75 FR 74818, Dec. 1, 2010, as amended at 76 FR 36342, June 22, 2011; 76 FR 59551, Sept. 27, 2011; 77 FR 10380, Feb. 22, 2012; 77 FR 48089, Aug. 13, 2012; 78 FR 68209, Nov. 13, 2013; 79 FR 73785, Dec. 11, 2014; 81 FR 89255, Dec. 9, 2016; 89 FR 31913, Apr. 25, 2024]



## § 98.95 Procedures for estimating missing data.

- (a) Except as provided in paragraph (b) of this section, a complete record of all measured parameters used in the fluorinated GHG and N<sub>2</sub>O emissions calculations in § 98.93 and § 98.94 is required.
- (b) If you use fluorinated heat transfer fluids at your facility and are missing data for one or more of the parameters in Equation I-16 of this subpart, you must estimate fluorinated heat transfer fluid emissions using the arithmetic average of the emission rates for the reporting year immediately preceding the period of missing data and the months immediately following the period of missing data. Alternatively, you may estimate missing information using records from the fluorinated heat transfer fluid supplier. You must document the method used and values used for all missing data values.

[75 FR 74818, Dec. 1, 2010, as amended at 77 FR 10381, Feb. 22, 2012]

## § 98.96 Data reporting requirements.

In addition to the information required by § 98.3(c), you must include in each annual report the following information for each electronics manufacturing facility:

- (a) Annual manufacturing capacity of each fab at your facility used to determine the annual manufacturing capacity of your facility in Equation I-5 of this subpart.
- (b) For facilities that manufacture semiconductors, the diameter of wafers manufactured at each fab at your facility (mm).
- (c) Annual emissions, on a fab basis as described in paragraph (c)(1) through (5) of this section.
  - (1) When you use the procedures specified in § 98.93(a), each fluorinated GHG emitted from each process type for which your fab is required to calculate emissions as calculated in equations I-6, I-7, and I-9 to § 98.93.
  - (2) When you use the procedures specified in § 98.93(a), each fluorinated GHG emitted from each process type or process sub-type as calculated in equations I-8A and I-8B to § 98.93, as applicable.
  - (3) N<sub>2</sub>O emitted from all chemical vapor deposition processes and N<sub>2</sub>O emitted from the aggregate of other N<sub>2</sub>O-using manufacturing processes as calculated in Equation I-10 of this subpart.
  - (4) Each fluorinated heat transfer fluid emitted as calculated in Equation I-16 of this subpart.
  - (5) When you use the procedures specified in § 98.93(i) of this subpart, annual emissions of each fluorinated GHG, on a fab basis.
- (d) The method of emissions calculation used in § 98.93 for each fab.
- (e) Annual production in terms of substrate surface area (e.g., silicon, PV-cell, glass) for each fab, including specification of the substrate.
- (f)-(l) [Reserved]
- (m) For the fab-specific apportioning model used to apportion fluorinated GHG and N<sub>2</sub>O consumption under § 98.94(c), the following information to determine it is verified in accordance with procedures in § 98.94(c)(1) and (2):

- (1) Identification of the quantifiable metric used in your fab-specific engineering model to apportion gas consumption for each fab, and/or an indication if direct measurements were used in addition to, or instead of, a quantifiable metric.
  - (2) The start and end dates selected under § 98.94(c)(2)(i).
  - (3) Certification that the gas(es) you selected under § 98.94(c)(2)(ii) for each fab corresponds to the largest quantity(ies) consumed, on a mass basis, of fluorinated GHG used at your fab during the reporting year for which you are required to apportion.
  - (4) The result of the calculation comparing the actual and modeled gas consumption under § 98.94(c)(2)(iii) and (iv), as applicable.
  - (5) If you are required to apportion fluorinated GHG consumption between fabs as required by § 98.94(c)(2)(v), certification that the gas(es) you selected under § 98.94(c)(2)(ii) corresponds to the largest quantity(ies) consumed on a mass basis, of fluorinated GHG used at your facility during the reporting year for which you are required to apportion.
- (n) [Reserved]
- (o) For all HC fuel CECS that were purchased and installed on or after January 1, 2025, that are used to control emissions from tools that use either  $\text{NF}_3$  as an input gas in remote plasma clean processes or  $\text{F}_2$  as an input gas in any process type or sub-type and for which you are not calculating emissions under equation I-9 to § 98.93, certification that the rate of conversion from  $\text{F}_2$  to  $\text{CF}_4$  is  $<0.1\%$  and that the systems are installed, operated, and maintained in accordance with the directions of the HC fuel CECS manufacturer. Hydrocarbon-fuel-based combustion emissions control systems include but are not limited to abatement systems as defined in § 98.98 that are hydrocarbon-fuel-based. If you make the certification based on your own testing, you must certify that you tested the model of the system according to the requirements specified in § 98.94(e). If you make the certification based on testing by the HC fuel CECS manufacturer, you must provide documentation from the HC fuel CECS manufacturer that the rate of conversion from  $\text{F}_2$  to  $\text{CF}_4$  is  $<0.1\%$  when tested according to the requirements specified in § 98.94(e).
- (p) Inventory and description of all abatement systems through which fluorinated GHGs or  $\text{N}_2\text{O}$  flow at your facility and for which you are claiming destruction or removal efficiency, including:
- (1) The number of abatement systems controlling emissions for each process sub-type, or process type, as applicable, for each gas used in the process sub-type or process type.
  - (2) The basis of the destruction or removal efficiency being used (default, manufacturer-verified, or site-specific measurement according to § 98.94(f)(4)(i)) for each process sub-type or process type and for each gas.
- (q) For all abatement systems through which fluorinated GHGs or  $\text{N}_2\text{O}$  flow at your facility, for which you are reporting controlled emissions, the following:
- (1) Certification that all abatement systems at the facility have been installed, maintained, and operated in accordance with the site maintenance plan for abatement systems that is developed and maintained in your records as specified in § 98.97(d)(9).
  - (2) If you use default destruction or removal efficiency values in your emissions calculations under § 98.93(a), (b), or (i), certification that the site maintenance plan for abatement systems for which emissions are being reported contains the manufacturer's recommendations and specifications for installation, operation, and maintenance for each abatement system. To use the default or lower

manufacturer-verified destruction or removal efficiency values, operation of the abatement system must be within manufacturer's specifications, which may include, for example, specifications on vacuum pumps' purges, fuel and oxidizer settings, supply and exhaust flows and pressures, and utilities to the emissions control equipment including fuel gas flow and pressure, calorific value, and water quality, flow and pressure.

- (3) If you use default destruction or removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i), certification that the abatement systems for which emissions are being reported were specifically designed for fluorinated GHG or N<sub>2</sub>O abatement, as applicable. You must support this certification by providing abatement system supplier documentation stating that the system was designed for fluorinated GHG or N<sub>2</sub>O abatement, as applicable, and supply the destruction or removal efficiency value at which each abatement system is certified for the fluorinated GHG or N<sub>2</sub>O abated, as applicable. You may only use the default destruction or removal efficiency value if the abatement system is verified to meet or exceed the destruction or removal efficiency default value in table I-16 to this subpart. If the system is verified at a destruction or removal efficiency value lower than the default value, you may use the verified value.
- (4) For all stack systems for which you calculate fluorinated GHG emissions according to the procedures specified in § 98.93(i)(3), certification that you have included and accounted for all abatement systems and any respective downtime in your emissions calculations under § 98.93(i)(3).
- (r) You must report an effective fab-wide destruction or removal efficiency value for each fab at your facility calculated using Equation I-26, I-27, and I-28 of this subpart, as appropriate.

$$DRE_{FAB} = 1 - \left[ \frac{\sum_i FGHG_i * GWP_i + \sum_j N_2O_j * GWP_{N_2O}}{UAFGHG + SFGHG + \sum_j C_{N_2O,j} * (1 - U_{N_2O,j}) * GWP_{N_2O}} \right] \quad (\text{Eq. I-26})$$

Where:

$DRE_{FAB}$  = Fab-wide effective destruction or removal efficiency value, expressed as a decimal fraction.

$FGHG_i$  = Total emissions of each fluorinated GHG  $i$  emitted from electronics manufacturing processes in the fab, calculated according to the procedures in § 98.93.

$N_2O_j$  = Emissions of N<sub>2</sub>O from each N<sub>2</sub>O-emitting electronics manufacturing process  $j$  in the fab, expressed in metric ton CO<sub>2</sub> equivalents, calculated according to the procedures in § 98.93.

$UAFGHG$  = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton CO<sub>2</sub> equivalents as calculated in Equation I-27 of this subpart.

$SFGHG$  = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton CO<sub>2</sub> equivalents, as calculated in Equation I-28 of this subpart.

$C_{N_2O,j}$  = Consumption of N<sub>2</sub>O in each N<sub>2</sub>O emitting process  $j$ , expressed in metric ton CO<sub>2</sub> equivalents.

$1 - U_{N_2O,j}$  = N<sub>2</sub>O emission factor for each N<sub>2</sub>O emitting process  $j$  from Table I-8 of this subpart.

$GWP_i$  = GWP of emitted fluorinated GHG  $i$  from Table A-1 of this part.

$GWP_{N_2O}$  = GWP of  $N_2O$  from Table A-1 of this part.

$i$  = Fluorinated GHG.

$j$  = Process Type.

- (1) Use Equation I-27 of this subpart to calculate total unabated emissions, in metric tons  $CO_2e$ , of all fluorinated GHG emitted from electronics manufacturing processes whose emissions of fluorinated GHG you calculated according to the default utilization and by-product formation rate procedures in § 98.93(a) or § 98.93(i)(4). For each fluorinated GHG  $i$  in process  $j$ , use the same consumption ( $C_{ij}$ ), emission factors ( $1-U_{ij}$ ), and by-product formation rates ( $B_{ijk}$ ) to calculate unabated emissions as you used to calculate emissions in § 98.93(a) or § 98.93(i)(4).

$$UAFGHG = \sum_i \sum_j C_{ij} * (1 - U_{ij}) * GWP_i + \sum_i \sum_j C_{ij} * B_{ijk} * GWP_k \quad (\text{Eq. I-27})$$

Where:

$UAFGHG$  = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton  $CO_2e$  for which you calculated total emission according to the procedures in § 98.93(a) or § 98.93(i)(4).

$C_{ij}$  = Total consumption of fluorinated GHG  $i$ , apportioned to process  $j$ , expressed in metric ton  $CO_2e$ , which you used to calculate total emissions according to the procedures in § 98.93(a) or § 98.93(i)(4).

$U_{ij}$  = Process utilization rate for fluorinated GHG  $i$ , process type  $j$ , which you used to calculate total emissions according to the procedures in § 98.93(a) or § 98.93(i)(4).

$GWP_i$  = GWP of emitted fluorinated GHG  $i$  from Table A-1 of this part.

$GWP_k$  = GWP of emitted fluorinated GHG by-product  $k$  from Table A-1 of this part.

$B_{ijk}$  = By-product formation rate of fluorinated GHG  $k$  created as a by-product per amount of fluorinated GHG input gas  $i$  (kg) consumed by process type  $j$  (kg).

$i$  = Fluorinated GHG.

$j$  = Process Type.

$k$  = Fluorinated GHG by-product.

- (2) Use equation I-28 to this section to calculate total unabated emissions, in metric ton  $CO_2e$ , of all fluorinated GHG emitted from electronics manufacturing processes whose emissions of fluorinated GHG you calculated according to the stack testing procedures in § 98.93(i)(3). For each set of

processes, use the same input gas consumption ( $C_{if}$ ), input gas emission factors ( $EF_{if}$ ), by-product gas emission factors ( $EF_{kf}$ ), fractions of tools abated ( $a_{if}$  and  $a_{kif}$ ), and destruction efficiencies ( $d_{if}$  and  $d_{ik}$ ) to calculate unabated emissions as you used to calculate emissions.

$$SFGHG = \sum_i \left[ \frac{EF_{if}}{(1 - (a_{if} * d_{if}))} * C_{if} * GWP_i \right] + \sum_k \left[ EF_{kf} * \sum_i \frac{C_{if}}{1 - (a_{kif} * d_{ik})} * GWP_k \right] \quad \text{Eq. I-28}$$

Where:

$SFGHG$  = Total unabated emissions of fluorinated GHG emitted from electronics manufacturing processes in the fab, expressed in metric ton  $CO_2e$  for which you calculated total emission according to the procedures in § 98.93(i)(3).

$EF_{if}$  = Emission factor for fluorinated GHG input gas  $i$ , emitted from fab  $f$ , as calculated in equation I-19 to § 98.93 (kg emitted/kg input gas consumed).

$a_{if}$  = Fraction of fluorinated GHG input gas  $i$  used in fab  $f$  in tools with abatement systems (expressed as a decimal fraction).

$d_{if}$  = Fraction of fluorinated GHG  $i$  destroyed or removed in abatement systems connected to process tools in fab  $f$ , as calculated from equation I-24A to § 98.93, which you used to calculate total emissions according to the procedures in § 98.93(i)(3) (expressed as a decimal fraction).

$C_{if}$  = Total consumption of fluorinated GHG input gas  $i$ , of tools vented to stack systems, for fab  $f$ , for the reporting year, expressed in metric ton  $CO_2e$ , which you used to calculate total emissions according to the procedures in § 98.93(i)(3) (expressed as a decimal fraction).

$EF_{kf}$  = Emission factor for fluorinated GHG by-product gas  $k$ , emitted from fab  $f$ , as calculated in equation I-20 to § 98.93 (kg emitted/kg of all input gases consumed in tools vented to stack systems).

$a_{kif}$  = Fraction of fluorinated GHG by-product gas  $k$  emitted in fab  $f$  from tools using input gas  $i$  with abatement systems (expressed as a decimal fraction), as calculated using equation I-24D to § 98.93.

$d_{ik}$  = Fraction of fluorinated GHG byproduct  $k$  destroyed or removed in abatement systems connected to process tools in fab  $f$ , as calculated from equation I-24B to § 98.93, which you used to calculate total emissions according to the procedures in § 98.93(i)(3) (expressed as a decimal fraction).

$GWP_i$  = GWP of emitted fluorinated GHG  $i$  from table A-1 to subpart A of this part.

$GWP_k$  = GWP of emitted fluorinated GHG by-product  $k$  from table A-1 to subpart A of this part.

$i$  = Fluorinated GHG.

$k$  = Fluorinated GHG by-product.

- (s) Where missing data procedures were used to estimate inputs into the fluorinated heat transfer fluid mass balance equation under § 98.95(b), the number of times missing data procedures were followed in the reporting year and the method used to estimate the missing data.

(t)-(v) [Reserved]

- (w) If you elect to calculate fab-level emissions of fluorinated GHG using the stack test methods specified in § 98.93(i), you must report the following in paragraphs (w)(1) and (2) for each stack system, in addition to the relevant data in paragraphs (a) through (v) of this section:
- (1) The date of any stack testing conducted during the reporting year, and the identity of the stack system tested.
  - (2) An inventory of all stack systems from which process fluorinated GHG are emitted.
- (x) If the emissions you report under paragraph (c) of this section include emissions from research and development activities, as defined in § 98.6, report the approximate percentage of total GHG emissions, on a metric ton CO<sub>2</sub>e basis, that are attributable to research and development activities, using the following ranges: less than 5 percent, 5 percent to less than 10 percent, 10 percent to less than 25 percent, 25 percent to less than 50 percent, 50 percent and higher.
- (y) If your semiconductor manufacturing facility manufactures wafers greater than 150 mm and emits more than 40,000 metric ton CO<sub>2</sub>e of GHG emissions, based on your most recently submitted annual report as required in paragraph (c) of this section, from the electronics manufacturing processes subject to reporting under this subpart, you must prepare and submit a technology assessment report every five years to the Administrator (or an authorized representative) that meets the requirements specified in paragraphs (y)(1) through (6) of this section. Any other semiconductor manufacturing facility may voluntarily submit this report to the Administrator. If your semiconductor manufacturing facility manufactures only 150 mm or smaller wafers, you are not required to prepare and submit a technology assessment report, but you are required to prepare and submit a report if your facility begins manufacturing wafers 200 mm or larger during or before the calendar year preceding the year the technology assessment report is due. If your semiconductor manufacturing facility is no longer required to report to the GHGRP under subpart I due to the cessation of semiconductor manufacturing as described in § 98.2(i)(3), you are not required to submit a technology assessment report.
- (1) The first technology assessment report due after January 1, 2025, is due on March 31, 2028, and subsequent reports must be delivered every 5 years no later than March 31 of the year in which it is due.
  - (2) The report must include the information described in paragraphs (y)(2)(i) through (v) of this section.
    - (i) It must describe how the gases and technologies used in semiconductor manufacturing using 200 mm and 300 mm wafers in the United States have changed in the past 5 years and whether any of the identified changes are likely to have affected the emissions characteristics of semiconductor manufacturing processes in such a way that the default utilization and by-product formation rates or default destruction or removal efficiency factors of this subpart may need to be updated.
    - (ii) It must describe the effect on emissions of the implementation of new process technologies and/or finer line width processes in 200 mm and 300 mm technologies, the introduction of new tool platforms, and the introduction of new processes on previously tested platforms.
    - (iii) It must describe the status of implementing 450 mm wafer technology and the potential need to create or update default emission factors compared to 300 mm technology.

(iv) It must provide any utilization and byproduct formation rates and/or destruction or removal efficiency data that have been collected in the previous 5 years that support the changes in semiconductor manufacturing processes described in the report. Any utilization or byproduct formation rate data submitted must be reported using both of the methods specified in paragraphs (y)(2)(iv)(A) and (B) of this section if multiple fluorinated input gases are used, unless one of the input gases does not have a reference process utilization rate in table I-19 or I-20 to this subpart for the process type and wafer size whose emission factors are being measured, in which case the data must be submitted using the method specified in paragraph (y)(2)(iv)(A) of this section. If only one fluorinated input gas is fed into the process, you must use equations I-29A and I-29B to this section. In addition to using the methods specified in paragraphs (y)(2)(iv)(A) and (B) of this section, you have the option to calculate and report the utilization or byproduct formation rate data using any alternative calculation methodology. The report must include the input gases used and measured, the utilization rates measured, the byproduct formation rates measured, the process type, the process subtype for chamber clean processes, the wafer size, and the methods used for the measurements. The report must also specify the method used to calculate each reported utilization and by-product formation rate, and provide a unique record number for each data set. For any destruction or removal efficiency data submitted, the report must include the input gases used and measured, the destruction and removal efficiency measured, the process type, the methods used for the measurements, and whether the abatement system is specifically designed to abate the gas measured under the operating conditions used for the measurement. If you choose to use an additional alternative calculation methodology to calculate and report the input gas emission factors and by-product formation rates, you must provide a complete, mathematical description of the alternative method used (including the equation used to calculate each reported utilization and by-product formation rate) and include the information in this paragraph (y)(2)(iv).

(A) **All-input gas method.** Use equation I-29A to this section to calculate the input gas emission factor  $(1 - U_{ij})$  for each input gas in a single test. If the result of equation I-29A exceeds 0.8 for an F-GHG that contains carbon, you must use equation I-29C to this section to calculate the input gas emission factor for that F-GHG and equation I-29D to this section to calculate the by-product formation rate for that F-GHG from the other input gases. Use equation I-29B to this section to calculate the by-product formation rates from each input gas for F-GHGs that are not input gases. If a test uses a cleaning or etching gas that does not contain carbon in combination with a cleaning or etching gas that does contain carbon and the process chamber is not used to etch or deposit carbon-containing films, you may elect to assign carbon containing by-products only to the carbon-containing input gases. If you choose to assign carbon containing by-products only to carbon-containing input gases, remove the input mass of the non-carbon containing gases from the sum of  $Mass_i$  and the sum of  $Mass_g$  in equations I-29B and I-29D to this section, respectively.

$$(1 - U_{ij}) = \frac{(E_i)}{(Mass_i)} \quad (Eq. I-29A)$$

Where:

$U_{ij}$  = Process utilization rate for fluorinated GHG i, process type j.

$E_i$  = The mass emissions of input gas i.

$Mass_i$  = The mass of input gas  $i$  fed into the process.

$i$  = Fluorinated GHG.

$j$  = Process type.

$$BEF_{kji} = \frac{(E_k)}{\sum_i Mass_i} \quad (Eq. I-29B)$$

Where:

$BEF_{kji}$  = By-product formation rate for gas  $k$  from input gas  $i$ , for process type  $j$ , where gas  $k$  is not an input gas.

$E_k$  = The mass emissions of by-product gas  $k$ .

$Mass_i$  = The mass of input gas  $i$  fed into the process.

$i$  = Fluorinated GHG.

$j$  = Process type.

$k$  = Fluorinated GHG by-product.

$$(1 - U_{ij}) = 0.8 \quad (Eq. I-29C)$$

Where:

$U_{ij}$  = Process utilization rate for fluorinated GHG  $i$ , process type  $j$ .

$$BEF_{ijg} = \frac{(E_i - 0.8 * Mass_i)}{\sum_g Mass_g} \quad (Eq. I-29D)$$

Where:

$BEF_{ijg}$  = By-product formation rate for gas  $i$  from input gas  $g$  for process type  $j$ .

$E_i$  = The mass emissions of input gas  $i$ .

$Mass_i$  = The mass of input gas  $i$  fed into the process.

$Mass_g$  = The mass of input gas  $g$  fed into the process, where  $g$  does not equal input gas  $i$ .

$i$  = Fluorinated GHG.

$g$  = Fluorinated GHG input gas, where gas  $g$  is not equal to gas  $i$ .

$j$  = Process type.



- (B) **Reference emission factor method.** Calculate the input gas emission factors and by-product formation rates from a test using equations I-30A, I-30B, and I-29B to this section, and table I-19 or I-20 to this subpart. In this case, use equation I-30A to this section to calculate the input gas emission factors and use equation I-30B and I-29B to this section to calculate the by-product formation rates.

$$(1 - U_{ij}) = (1 - U_{ijr}) * \left[ \frac{E_i}{(\text{Mass}_i * (1 - U_{ijr}) + \sum_g \text{Mass}_g \text{BEF}_{ijgr})} \right] \quad (\text{Eq. I-30A})$$

Where:

$U_{ij}$  = Process utilization rate for fluorinated GHG i, process type j.

$U_{ijr}$  = Reference process utilization rate for fluorinated GHG i, process type j, for input gas i, using table I-19 or I-20 to this subpart as appropriate.

$E_i$  = The mass emissions of input gas i.

$\text{Mass}_i$  = The mass of gas i fed into the process.

$\text{Mass}_g$  = The mass of input gas g fed into the process, where g does not equal input gas i.

$\text{BEF}_{ijgr}$  = Reference by-product formation rate for gas i from input gas g for process type j, using table I-19 or I-20 to this subpart as appropriate.

i = Fluorinated GHG.

g = Fluorinated GHG input gas, where gas g is not equal to gas i.

r = Reference data.

$$\text{BEF}_{ijg} = \text{BEF}_{ijgr} * \left[ \frac{E_i}{(\text{Mass}_i * (1 - U_{ijr}) + \sum_g \text{Mass}_g \text{BEF}_{ijgr})} \right] \quad (\text{Eq. I-30B})$$

Where:

$\text{BEF}_{ijg}$  = By-product formation rate for gas i from input gas g for process type j, where gas i is also an input gas.

$\text{BEF}_{ijgr}$  = Reference by-product formation rate for gas i from input gas g for process type j from table I-19 or I-20 to this subpart, as appropriate.

$U_{ijr}$  = Reference process utilization rate for fluorinated GHG i, process type j, for input gas i, using table I-19 or I-20 to this subpart, as appropriate.

$E_i$  = The mass emissions of input gas i.

$\text{Mass}_i$  = The mass of gas i fed into the process.

Mass<sub>g</sub> = The mass of input gas g fed into the process, where g does not equal input gas i.

i = Fluorinated GHG.

j = Process type.

g = Fluorinated GHG input gas, where gas g is not equal to gas i.

r = Reference data.

- (v) It must describe the use of a new gas, use of an existing gas in a new process type or sub-type, or a fundamental change in process technology.
- (3) If, on the basis of the information reported in paragraph (y)(2) of this section, the report indicates that GHG emissions from semiconductor manufacturing may have changed from those represented by the default utilization and by-product formation rates in Tables I-3 or I-4, or the default destruction or removal efficiency values in Table I-16 of this subpart, the report must lay out a data gathering and analysis plan focused on the areas of potential change. The plan must describe the elements in paragraphs (y)(3)(i) and (ii).
  - (i) The testing of tools to determine the potential effect on current utilization and by-product formation rates and destruction or removal efficiency values under the new conditions.
  - (ii) A planned analysis of the effect on overall facility emissions using a representative gas-use profile for a 200 mm, 300 mm, or 450 mm fab (depending on which technology is under consideration).
- (4) Multiple semiconductor manufacturing facilities may submit a single consolidated technology assessment report as long as the facility identifying information in § 98.3(c)(1) and the certification statement in § 98.3(c)(9) is provided for each facility for which the consolidated report is submitted.
- (5) The Administrator will review the report received and determine whether it is necessary to update the default utilization rates and by-product formation rates in Tables I-3, I-4, I-11, and I-12 of this subpart and default destruction or removal efficiency values in Table I-16 of this subpart based on the following:
  - (i) Whether the revised default utilization and by-product formation rates and destruction or removal efficiency values will result in a projected shift in emissions of 10 percent or greater.
  - (ii) Whether new platforms, processes, or facilities that are not captured in current default utilization and by-product formation rates and destruction or removal efficiency values should be included in revised values.
  - (iii) Whether new data are available that could expand the existing data set to include new gases, tools, or processes not included in the existing data set (i.e. gases, tools, or processes for which no data are currently available).
- (6) The Administrator will review the reports within 120 days and will notify you of a determination whether it is necessary to update any default utilization and by-product formation rates and/or destruction or removal efficiency values. If the Administrator determines it is necessary to update

default utilization and by-product formation rates and/or destruction or removal efficiency values, you will then have 180 days from the date you receive notice of the determination to execute the data collection and analysis plan described in the report and submit those data to the Administrator.

[75 FR 74818, Dec. 1, 2010, as amended at 77 FR 10381, Feb. 22, 2010; 78 FR 68215, Nov. 13, 2013; 78 FR 71954, Nov. 29, 2013; 79 FR 73785, Dec. 11, 2014; 81 FR 9255, Dec. 9, 2016; 89 FR 31915, Apr. 25, 2024]

## § 98.97 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the following records:

- (a) All data used and copies of calculations made as part of estimating gas consumption and emissions, including all spreadsheets.
- (b) If you use HC fuel CECS purchased and installed on or after January 1, 2025, to control emissions from tools that use either  $\text{NF}_3$  as an input gas in remote plasma cleaning processes or  $\text{F}_2$  as an input gas in any process, and if you use a value less than 1 for either  $a_{\text{F}_2, j}$  or  $a_{\text{NF}_3, \text{RPC}}$  in equation I-9 to § 98.93, certification and documentation that the model for each of the systems that you claim does not form  $\text{CF}_4$  from  $\text{F}_2$  has been tested and verified to produce less than 0.1%  $\text{CF}_4$  from  $\text{F}_2$ , and certification that the site maintenance plan includes the HC fuel CECS manufacturer's recommendations and specifications for installation, operation, and maintenance of those systems. If you are relying on your own testing to make the certification that the model produces less than 0.1%  $\text{CF}_4$  from  $\text{F}_2$ , the documentation must include the model tested, the method used to perform the testing (e.g., EPA 430-R-10-003, modified to calculate the formation rate of  $\text{CF}_4$  from  $\text{F}_2$  rather than the DRE), complete documentation of the results of any initial and subsequent tests, and a final report similar to that specified in EPA 430-R-10-003 (incorporated by reference, see § 98.7), with appropriate adjustments to reflect the measurement of the formation rate of  $\text{CF}_4$  from  $\text{F}_2$  rather than the DRE. If you are relying on testing by the HC fuel CECS manufacturer to make the certification that the system produces less than 0.1%  $\text{CF}_4$  from  $\text{F}_2$ , the documentation must include the model tested, the method used to perform the testing, and the results of the test.
- (c) Documentation for the fab-specific engineering model used to apportion fluorinated GHG and  $\text{N}_2\text{O}$  consumption. This documentation must be part of your site GHG Monitoring Plan as required under § 98.3(g)(5). At a minimum, you must retain the following:
  - (1) A clear, detailed description of the fab-specific model, including how it was developed; the quantifiable metric used in the model; all sources of information, equations, and formulas, each with clear definitions of terms and variables; all apportioning factors used to apportion fluorinated GHG and  $\text{N}_2\text{O}$ ; and a clear record of any changes made to the model while it was used to apportion fluorinated GHG and  $\text{N}_2\text{O}$  consumption across process sub-types, process types, tools with and without abatement systems, stack systems, and/or fabs.
  - (2) Sample calculations used for developing the gas apportioning factors ( $f_{ij}$ ) for the two fluorinated GHGs used at your facility in the largest quantities, on a mass basis, during the reporting year.
  - (3) If you develop apportioning factors through the use of direct measurement according to § 98.94(c)(3), calculations and data used to develop each gas apportioning factor.
  - (4) Calculations and data used to determine and document that the fab was operating at representative operating levels, as defined in § 98.98, during the apportioning model verification specified in § 98.94(c).

- (d) For all abatement systems through which fluorinated GHGs or N<sub>2</sub>O flow at your facility, and for which you are reporting controlled emissions, the following in paragraphs (d)(1) to (9) of this section:
- (1) Records of the information in paragraphs (d)(1)(i) through (iv) of this section:
- (i) Documentation to certify that each abatement system or group of abatement systems is installed, maintained, and operated in accordance with the site maintenance plan for abatement systems that is specified in paragraph (d)(9) of this section.
  - (ii) Documentation from the abatement system supplier describing the abatement system's designed purpose and emission control capabilities for fluorinated GHG and N<sub>2</sub>O for which the systems or group of systems is certified to abate, where available.
  - (iii) If you use either default destruction or removal efficiency values or certified destruction or removal efficiency values that are lower than the default values in your emissions calculations under § 98.93(a), (b), and/or (i), certification that the abatement systems for which emissions are being reported were specifically designed for fluorinated GHG and N<sub>2</sub>O abatement, as required under § 98.94(f)(3), certification that the site maintenance plan includes the abatement system manufacturer's recommendations and specifications for installation, operation, and maintenance, and the certified destruction and removal efficiency values for all applicable abatement systems. For abatement systems purchased and installed on or after January 1, 2025, also include records of the method used to measure the destruction and removal efficiency values.
  - (iv) Certification that you have included and accounted for all abatement systems and any respective downtime in your emissions calculations under § 98.93(i)(3), as required under § 98.94(f)(3).
- (2) Abatement system calibration and maintenance records.
- (3) Where either the default destruction or removal efficiency value or a certified destruction or removal efficiency value that is lower than the default is used, documentation from the abatement system supplier describing the equipment's designed purpose and emission control capabilities for fluorinated GHG and N<sub>2</sub>O.
- (4) Where properly measured site-specific destruction or removal efficiencies are used to report emissions, the information in paragraphs (d)(4)(i) through (vi) of this section:
- (i) Dated certification by the technician who made the measurement that the destruction or removal efficiency is calculated in accordance with methods in EPA 430-R-10-003 (incorporated by reference, see § 98.7) and, if applicable Appendix A of this subpart, or an alternative method approved by the Administrator as specified in § 98.94(k), complete documentation of the results of any initial and subsequent tests, the final report as specified in EPA 430-R-10-003 (incorporated by reference, see § 98.7) and, if applicable, the records and documentation specified in Appendix A of this subpart including the information required in paragraph (b)(7) of Appendix A of this subpart, or a final report as specified in an alternative method approved by the Administrator as specified in § 98.94(k).
  - (ii) The average destruction or removal efficiency of the abatement systems operating during the reporting year for each process type and gas combination.
  - (iii) A description of the calculation used to determine the average destruction or removal efficiency for each process type and gas combination, including all inputs to the calculation.

- (iv) The records of destruction or removal efficiency measurements for abatement systems for all tests that have been used to determine the site-specific destruction or removal efficiencies currently being used.
  - (v) A description of the method used for randomly selecting abatement systems for testing.
  - (vi) The total number of systems for which destruction or removal efficiency was properly measured for each process type and gas combination for the reporting year.
- (5) In addition to the inventory specified in § 98.96(p), the information in paragraphs (d)(5)(i) through (iii) of this section:
- (i) The number of abatement systems of each manufacturer, and model numbers, and the manufacturer's certified fluorinated GHG and N<sub>2</sub>O destruction or removal efficiency, if any.
  - (ii) Records of destruction or removal efficiency measurements over the in-use life of each abatement system.
  - (iii) A description of the tool, with the process type or sub-type, for which the abatement system treats exhaust.
- (6) Records of all inputs and results of calculations made accounting for the uptime of abatement systems used during the reporting year, in accordance with equations I-15 or I-23 to § 98.93, as applicable. The inputs should include an indication of whether each value for destruction or removal efficiency is a default value, lower manufacturer-verified value, or a measured site-specific value.
- (7) Records of all inputs and results of calculations made to determine the average weighted fraction of each gas destroyed or removed in the abatement systems for each stack system using equations I-24A and I-24B to § 98.93, if applicable. The inputs should include an indication of whether each value for destruction or removal efficiency is a default value, lower manufacturer-verified value, or a measured site-specific value.
- (8) Records of all inputs and the results of the calculation of the facility-wide emission destruction or removal efficiency factor calculated according to Equations I-26, I-27, and I-28 of this subpart.
- (9) A site maintenance plan for abatement systems, which must be maintained on-site at the facility as part of the facility's GHG Monitoring Plan as described in § 98.3(g)(5), and be developed and implemented according to paragraphs (d)(9)(i) through (iii) of this section.
- (i) The site maintenance plan for abatement systems must be based on the abatement system manufacturer's recommendations and specifications for installation, operation, and maintenance if you use default or lower manufacturer-verified destruction and removal efficiency values in your emissions calculations under § 98.93(a), (b), and/or (i). If the manufacturer's recommendations and specifications for installation, operation, and maintenance are not available, you cannot use default destruction and removal efficiency values or lower manufacturer-verified value in your emissions calculations under § 98.93(a), (b), and/or (i). If you use an average of properly measured destruction or removal efficiencies determined in accordance with the procedures in § 98.94(f)(4)(i) through (vi), the site maintenance plan for abatement systems must be based on the abatement system manufacturer's recommendations and specifications for installation, operation, and maintenance, where available. If you deviate from the manufacturer's recommendations and

specifications, you must include documentation that demonstrates how the deviations do not negatively affect the performance or destruction or removal efficiency of the abatement systems.

(ii) The site maintenance plan for abatement systems must include a defined preventative maintenance process and checklist.

(iii) The site maintenance plan for abatement systems must include a corrective action process that you must follow whenever an abatement system is found to be not operating properly.

(e) Purchase records for gas purchased.

(f) Invoices for gas purchases and sales.

(g) Documents and records used to monitor and calculate abatement system uptime.

(h) GHG Monitoring Plans, as described in § 98.3(g)(5), must be completed by April 1, 2011. You must update your GHG Monitoring Plan to comply with § 98.94(c) consistent with the requirements in § 98.3(g)(5)(iii).

(i) Retain the following records for each fab for which you elect to calculate fab-level emissions of fluorinated GHG using the procedures specified in § 98.93(i)(3) or (4).

(1) [Reserved]

(2) For each stack system, identify the method used to calculate annual emissions; either § 98.93(i)(3) or (4).

(3) The identity and total annual consumption of each gas identified as an intermittent low use fluorinated GHG as specified in § 98.93(i)(4)(i) and defined in § 98.98.

(4) The emissions test data and reports (see § 98.94(j)(4)) and the calculations used to determine the fab-specific emission factor, including the actual fab-specific emission factor, the average hourly emission rate of each fluorinated GHG from the stack system during the test and the stack system activity rate during the test. The report must also contain any changes in the stack system configuration during or between tests in a reporting year.

(5) The fab-specific emission factor and the calculations and data used to determine the fab-specific emission factor for each fluorinated GHG and by-product, as calculated using equations I-19A, I-19B, I-19C and I-20 to § 98.93(i)(3).

(6) Calculations and data used to determine annual emissions of each fluorinated GHG for each fab.

(7) Calculations and data used to determine and document that the fab was operating at representative operating levels, as defined in § 98.98, during the stack testing period.

(8) A copy of the certification that no significant changes in stack system flow configuration occurred between tests conducted for any particular fab in a reporting year, as required by § 98.94(j)(1)(iv) and any calculations and data supporting the certification.

(9) The number of tools vented to each stack system in the fab and all inputs and results for the calculations accounting for the fraction of gas exhausted through abatement systems using equations I-24C and I-24D to § 98.93.

- (j) If you report the approximate percentage of total GHG emissions from research and development activities under § 98.96(x), documentation for the determination of the percentage of total emissions of each fluorinated GHG and/or N<sub>2</sub>O attributable to research and development activities, as defined in § 98.6.
- (k) Annual gas consumption for each fluorinated GHG and N<sub>2</sub>O as calculated in equation I-11 to § 98.93, including where your fab used less than 50 kg of a particular fluorinated GHG or N<sub>2</sub>O used at your facility for which you have not calculated emissions using equations I-6, I-7, I-8A, I-8B, I-9, I-10, I-21, or I-22 to § 98.93, the chemical name of the GHG used, the annual consumption of the gas, and a brief description of its use.
- (l) All inputs used to calculate gas consumption in Equation I-11 of this subpart, for each fluorinated GHG and N<sub>2</sub>O used.
- (m) Annual amount of each fluorinated GHG consumed for process sub-type, process type, stack system, or fab, as appropriate, and the annual amount of N<sub>2</sub>O consumed for the aggregate of all chemical vapor deposition processes and for the aggregate of all other electronics manufacturing production processes, as calculated using Equation I-13 of this subpart.
- (n) Disbursements for each fluorinated GHG and N<sub>2</sub>O during the reporting year, as calculated using Equation I-12 of this subpart and all inputs used to calculate disbursements for each fluorinated GHG and N<sub>2</sub>O used in Equation I-12 of this subpart, including all fab-wide gas-specific heel factors used for each fluorinated GHG and N<sub>2</sub>O. If your fab used less than 50 kg of a particular fluorinated GHG during the reporting year, fab-wide gas-specific heel factors do not need to be reported for those gases.
- (o) Fraction of each fluorinated GHG or N<sub>2</sub>O fed into a process sub-type, process type, stack system, or fab that is fed into tools connected to abatement systems.
- (p) Fraction of each fluorinated GHG or N<sub>2</sub>O destroyed or removed in abatement systems connected to process tools where process sub-type, process type j is used, or to process tools vented to stack system j or fab f.
- (q) All inputs and results of calculations made accounting for the uptime of abatement systems used during the reporting year, or during an emissions sampling period, in accordance with Equations I-15 and/or I-23 of this subpart, as applicable.
- (r) For fluorinated heat transfer fluid emissions, inputs to the fluorinated heat transfer fluid mass balance equation, Equation I-16 of this subpart, for each fluorinated heat transfer fluid used.
- (s) Where missing data procedures were used to estimate inputs into the fluorinated heat transfer fluid mass balance equation under § 98.95(b), the estimates of those data.

[75 FR 74818, Dec. 1, 2010, as amended at 78 FR 68218, Nov. 13, 2013; 81 FR 9255, Dec. 9, 2016; 89 FR 31918, Apr. 25, 2024]

## § 98.98 Definitions.

Except as provided in this section, all of the terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part. If a conflict exists between a definition provided in this subpart and a definition provided in subpart A, the definition in this subpart takes precedence for the reporting requirements in this subpart.

**Abatement system** means a device or equipment that is designed to destroy or remove fluorinated GHGs or N<sub>2</sub>O in exhaust streams from one or more electronics manufacturing production processes, or for which the destruction or removal efficiency for a fluorinated GHG or N<sub>2</sub>O has been properly measured according to the procedures under § 98.94(f)(4), even if that abatement system is not designed to destroy or remove fluorinated GHGs or N<sub>2</sub>O. The device or equipment is only an abatement system for the individual fluorinated GHGs or N<sub>2</sub>O that it is designed to destroy or remove or for the individual fluorinated GHGs or N<sub>2</sub>O for which destruction or removal efficiencies were properly measured according to the procedures under § 98.94(f)(4).

**Actual gas consumption** means the quantity of gas used during wafer/substrate processing over some period based on a measured change in gas container weight or gas container pressure or on a measured volume of gas.

**By-product formation** means the creation of fluorinated GHGs during electronics manufacturing production processes or the creation of fluorinated GHGs by an abatement system. Where the procedures in § 98.93(a) are used to calculate annual emissions, by-product formation is the ratio of the mass of the by-product formed to the mass flow of the input gas. Where the procedures in § 98.93(i) are used to calculate annual emissions, by-product formation is the ratio of the mass of the by-product formed to the total mass flow of all fluorinated GHG input gases.

**Chamber cleaning** is a process type that consists of the process sub-types defined in paragraphs (1) through (3) of this definition.

- (1) In situ plasma process sub-type consists of the cleaning of thin-film production chambers, after processing substrates, with a fluorinated GHG cleaning reagent that is dissociated into its cleaning constituents by a plasma generated inside the chamber where the film is produced.
- (2) Remote plasma process sub-type consists of the cleaning of thin-film production chambers, after processing substrates, with a fluorinated GHG cleaning reagent dissociated by a remotely located plasma source.
- (3) In situ thermal process sub-type consists of the cleaning of thin-film production chambers, after processing substrates, with a fluorinated GHG cleaning reagent that is thermally dissociated into its cleaning constituents inside the chamber where thin films are produced.

**Controlled emissions** means the quantity of emissions that are released to the atmosphere after application of an emission control device (e.g., abatement system).

**Destruction or removal efficiency (DRE)** means the efficiency of an abatement system to destroy or remove fluorinated GHGs, N<sub>2</sub>O, or both. The destruction or removal efficiency is equal to one minus the ratio of the mass of all relevant GHGs exiting the abatement system to the mass of GHG entering the abatement system. When GHGs are formed in an abatement system, destruction or removal efficiency is expressed as one minus the ratio of amounts of exiting GHGs to the amounts entering the system in units of CO<sub>2</sub>-equivalents (CO<sub>2</sub>e).

**Fab** means the portion of an electronics manufacturing facility located in a separate physical structure that began manufacturing on a certain date.

**Fully fluorinated GHGs** means fluorinated GHGs that contain only single bonds and in which all available valence locations are filled by fluorine atoms. This includes, but is not limited to, saturated perfluorocarbons, SF<sub>6</sub>, NF<sub>3</sub>, SF<sub>5</sub>CF<sub>3</sub>, C<sub>4</sub>F<sub>8</sub>O, fully fluorinated linear, branched, and cyclic alkanes, fully fluorinated ethers, fully fluorinated tertiary amines, fully fluorinated aminoethers, and perfluoropolyethers.



**Gas utilization** means the fraction of input N<sub>2</sub>O or fluorinated GHG converted to other substances during the etching, deposition, and/or wafer and chamber cleaning processes. Gas utilization is expressed as a rate or factor for specific electronics manufacturing process sub-types or process types.

**Heel** means the amount of gas that remains in a gas container after it is discharged or off-loaded; heel may vary by container type.

**Hydrocarbon-fuel based combustion emission control system (HC fuel CECS)** means a hydrocarbon fuel-based combustion device or equipment that is designed to destroy or remove gas emissions in exhaust streams via combustion from one or more electronics manufacturing production processes, and that is connected to manufacturing tools that have the potential to emit F<sub>2</sub> or fluorinated greenhouse gases. HC fuel CECS include both emission control systems that are and are not designed to destroy or remove fluorinated GHGs or N<sub>2</sub>O.

**Input gas** means a fluorinated GHG or N<sub>2</sub>O used in one of the processes described in § 98.90(a)(1) through (4).

**Intermittent low-use fluorinated GHG**, for the purposes of determining fluorinated GHG emissions using the stack testing method, means a fluorinated GHG that meets all of the following:

- (1) The fluorinated GHG is used by the fab but is not used during the period of stack testing for the fab/stack system.
- (2) The emissions of the fluorinated GHG, estimated using the methods in § 98.93(i)(4) do not constitute more than 5 percent of the total fluorinated GHG emissions from the fab on a CO<sub>2</sub>e basis.
- (3) The sum of the emissions of all fluorinated GHGs that are considered intermittent low use gases does not exceed 10,000 metric tons CO<sub>2</sub>e for the fab for that year, as calculated using the procedures specified in § 98.93(i)(1) of this subpart.
- (4) The fluorinated GHG is not an expected or possible by-product identified in Table I-17 of this subpart.

**Maximum substrate starts** means for the purposes of Equation I-5 of this subpart, the maximum quantity of substrates, expressed as surface area, that could be started each month during a reporting year based on the equipment installed in that facility and assuming that the installed equipment were fully utilized. Manufacturing equipment is considered installed when it is on the manufacturing floor and connected to required utilities.

**Modeled gas consumed** means the quantity of gas used during wafer/substrate processing over some period based on a verified facility-specific engineering model used to apportion gas consumption.

**Nameplate capacity** means the full and proper charge of chemical specified by the equipment manufacturer to achieve the equipment's specified performance. The nameplate capacity is typically indicated on the equipment's nameplate; it is not necessarily the actual charge, which may be influenced by leakage and other emissions.

**Operational mode** means the time in which an abatement system is properly installed, maintained, and operated according to the site maintenance plan for abatement systems as required in § 98.94(f)(1) and defined in § 98.97(d)(9). This includes being properly operated within the range of parameters as specified in the site maintenance plan for abatement systems. For abatement systems purchased and installed on or after January 1, 2025, this includes being properly operated within the range of parameters specified in the DRE certification documentation. An abatement system is considered to not be in operational mode

when it is not operated and maintained according to the site maintenance plan for abatement systems or, for abatement systems purchased and installed on or after January 1, 2025, not operated within the range of parameters as specified in the DRE certification documentation.

**Plasma etching** is a process type that consists of any production process using fluorinated GHG reagents to selectively remove materials from a substrate during electronics manufacturing. The materials removed may include  $\text{SiO}_2$ ,  $\text{SiO}_x$ -based or fully organic-based thin-film material,  $\text{SiN}$ ,  $\text{SiON}$ ,  $\text{Si}_3\text{N}_4$ ,  $\text{SiC}$ ,  $\text{SiCO}$ ,  $\text{SiCN}$ , etc. (represented by the general chemical formula,  $\text{Si}_w\text{O}_x\text{N}_y\text{X}_z$  where  $w$ ,  $x$ ,  $y$  and  $z$  are zero or integers and  $X$  may be some other element such as carbon), substrate, or metal films (such as aluminum or tungsten).

**Process sub-type** is a set of similar manufacturing steps, more closely related within a broad process type. For example, the chamber cleaning process type includes in-situ plasma chamber cleaning, remote plasma chamber cleaning, and in-situ thermal chamber cleaning sub-types.

**Process types** are broad groups of manufacturing steps used at a facility associated with substrate (e.g., wafer) processing during device manufacture for which fluorinated GHG emissions and fluorinated GHG consumption is calculated and reported. The process types are Plasma etching/Wafer Cleaning and Chamber cleaning.

**Properly measured destruction or removal efficiency** means destruction or removal efficiencies measured in accordance with EPA 430-R-10-003 (incorporated by reference, see § 98.7), and, if applicable, Appendix A to this subpart, or by an alternative method approved by the Administrator as specified in § 98.94(k).

**The Random Sampling Abatement System Testing Program (RSASTP)** means the required frequency for measuring the destruction or removal efficiencies of abatement systems in order to apply properly measured destruction or removal efficiencies to report controlled emissions.

**Redundant abatement systems** means a system that is specifically designed, installed and operated for the purpose of destroying fluorinated GHGs and  $\text{N}_2\text{O}$  gases, or for which the destruction or removal efficiency for a fluorinated GHG or  $\text{N}_2\text{O}$  has been properly measured according to the procedures under § 98.94(f)(4), and that is used as a backup to the main fluorinated GHGs and  $\text{N}_2\text{O}$  abatement system during those times when the main system is not functioning or operating in accordance with design and operating specifications.

**Repeatable** means that the variables used in the formulas for the facility's engineering model for gas apportioning factors are based on observable and measurable quantities that govern gas consumption rather than engineering judgment about those quantities or gas consumption.

**Representative operating levels** means (for purposes of verification of the apportionment model or for determining the appropriate conditions for stack testing) operating the fab, in terms of substrate starts for the period of testing or monitoring, at no less than 50 percent of installed production capacity or no less than 70 percent of the average production rate for the reporting year, where production rate for the reporting year is represented in average monthly substrate starts. For the purposes of stack testing, the period for determining the representative operating level must be the period ending on the same date on which testing is concluded.

**Stack system** means one or more stacks that are connected by a common header or manifold, through which a fluorinated GHG-containing gas stream originating from one or more fab processes is, or has the potential to be, released to the atmosphere. For purposes of this subpart, stack systems do not include emergency vents or bypass stacks through which emissions are not usually vented under typical operating conditions.

*Trigger point for change out* means the residual weight or pressure of a gas container type that a facility uses as an indicator that operators need to change out that gas container with a full container. The trigger point is not the actual residual weight or pressure of the gas remaining in the cylinder that has been replaced.

*Unabated emissions* means a gas stream containing fluorinated GHG or N<sub>2</sub>O that has exited the process, but which has not yet been introduced into an abatement system to reduce the mass of fluorinated GHG or N<sub>2</sub>O in the stream. If the emissions from the process are not routed to an abatement system, or are routed to an abatement device that is not in an operational mode, unabated emissions are those fluorinated GHG or N<sub>2</sub>O released to the atmosphere.

*Uptime* means the ratio of the total time during which the abatement system is in an operational mode, to the total time during which production process tool(s) connected to that abatement system are normally in operation.

*Wafer cleaning* is a process type that consists of any production process using fluorinated GHG reagents to clean wafers at any step during production.

*Wafer passes* is a count of the number of times a wafer substrate is processed in a specific process sub-type, or type. The total number of wafer passes over a reporting year is the number of wafer passes per tool multiplied by the number of operational process tools in use during the reporting year.

*Wafer starts* means the number of fresh wafers that are introduced into the fabrication sequence each month. It includes test wafers, which means wafers that are exposed to all of the conditions of process characterization, including but not limited to actual etch conditions or actual film deposition conditions.

[75 FR 74818, Dec. 1, 2010, as amended at 77 FR 10381, Feb. 22, 2012; 78 FR 68220, Nov. 13, 2013; 89 FR 31919, Apr. 25, 2024]

## **Table I-1 to Subpart I of Part 98—Default Emission Factors for Manufacturing Capacity-Based Threshold Applicability Determination**

TABLE I-1 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS  
FOR MANUFACTURING CAPACITY-BASED THRESHOLD APPLICABILITY  
DETERMINATION

| Product type                        | Emission factors EF <sub>i</sub> |                               |                  |                                 |                               |                 |                 |                  |
|-------------------------------------|----------------------------------|-------------------------------|------------------|---------------------------------|-------------------------------|-----------------|-----------------|------------------|
|                                     | CF <sub>4</sub>                  | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | c-C <sub>4</sub> F <sub>8</sub> | C <sub>3</sub> F <sub>8</sub> | NF <sub>3</sub> | SF <sub>6</sub> | N <sub>2</sub> O |
| Semiconductors (kg/m <sup>2</sup> ) | 0.9                              | 1.0                           | 0.04             | NA                              | 0.05                          | 0.04            | 0.20            | NA               |
| LCD (g/m <sup>2</sup> )             | 0.65                             | NA                            | 0.0024           | 0.00                            | NA                            | 1.29            | 4.14            | 17.06            |
| MEMS (kg/m <sup>2</sup> )           | 0.015                            | NA                            | NA               | 0.076                           | NA                            | NA              | 1.86            | NA               |

NOTES: NA denotes not applicable based on currently available information.

[89 FR 31919, Apr. 25, 2024]

Table I-2 to Subpart I of Part 98—Default Emission Factors for Gas Consumption-Based Threshold Applicability Determination

TABLE I-2 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS FOR GAS CONSUMPTION-BASED THRESHOLD APPLICABILITY DETERMINATION

|                                | Process gas i    |                  |
|--------------------------------|------------------|------------------|
|                                | Fluorinated GHGs | N <sub>2</sub> O |
| 1-U <sub>i</sub>               | 0.8              | 1                |
| BCF <sub>4</sub>               | 0.15             | 0                |
| BC <sub>2</sub> F <sub>6</sub> | 0.05             | 0                |

[89 FR 31919, Apr. 25, 2024]

Table I-3 to Subpart I of Part 98—Default Emission Factors (1-U<sub>ij</sub>) for Gas Utilization Rates (U<sub>ij</sub>) and By-Product Formation Rates (B<sub>ijk</sub>) for Semiconductor Manufacturing for 150 mm and 200 mm Wafer Sizes

**TABLE I-3 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS (1-U<sub>ij</sub>) FOR GAS UTILIZATION RATES (U<sub>ij</sub>) AND BY-PRODUCT FORMATION RATES (B<sub>ijk</sub>) FOR SEMICONDUCTOR MANUFACTURING FOR 150 mm AND 200 mm WAFER SIZES**

| Process type/sub-type          | Process gas i   |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
|--------------------------------|-----------------|-------------------------------|------------------|--------------------------------|--------------------------------|-------------------|-------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|                                | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>2</sub> HF <sub>5</sub> | CH <sub>3</sub> F | C <sub>3</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| ETCHING/WAFER CLEANING         |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | 0.73            | 0.72                          | 0.51             | 0.13                           | 0.064                          | 0.70              | NA                            | 0.14                          | 0.19            | 0.55            | 0.083                         | 0.072                         | NA                              |
| BCF <sub>4</sub>               | NA              | 0.10                          | 0.085            | 0.079                          | 0.077                          | NA                | NA                            | 0.11                          | 0.0040          | 0.13            | 0.095                         | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub> | 0.041           | NA                            | 0.035            | 0.025                          | 0.024                          | 0.0034            | NA                            | 0.037                         | 0.025           | 0.11            | 0.073                         | 0.014                         | NA                              |
| BC <sub>4</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BCHF <sub>3</sub>              | 0.091           | 0.047                         | NA               | 0.049                          | NA                             | NA                | NA                            | 0.040                         | NA              | 0.0012          | 0.066                         | 0.0039                        | NA                              |
| CHAMBER CLEANING               |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| IN SITU PLASMA CLEANING        |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | 0.92            | 0.55                          | NA               | NA                             | NA                             | NA                | 0.40                          | 0.10                          | 0.18            | NA              | NA                            | NA                            | 0.14                            |
| BCF <sub>4</sub>               | NA              | 0.19                          | NA               | NA                             | NA                             | NA                | 0.20                          | 0.11                          | 0.14            | NA              | NA                            | NA                            | 0.13                            |
| BC <sub>2</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | 0.045                           |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| REMOTE PLASMA CLEANING         |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | 0.028           | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | 0.015           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BF <sub>2</sub>                | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | 0.5             | NA              | NA                            | NA                            | NA                              |
| IN SITU THERMAL CLEANING       |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |

NOTES: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

[89 FR 31920, Apr. 25, 2024]

**Table I-4 to Subpart I of Part 98— Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor Manufacturing for 300 mm and 450 mm Wafer Size**

**TABLE I-4 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS (1-U<sub>ij</sub>) FOR GAS UTILIZATION RATES (U<sub>ij</sub>) AND BY-PRODUCT FORMATION RATES (B<sub>ijk</sub>) FOR SEMICONDUCTOR MANUFACTURING FOR 300 mm AND 450 mm WAFER SIZE**

| Process type/sub-type           | Process gas i   |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
|---------------------------------|-----------------|-------------------------------|------------------|--------------------------------|-------------------|-------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|                                 | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | CH <sub>3</sub> F | C <sub>3</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| ETCHING/WAFER CLEANING          |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | 0.65            | 0.80                          | 0.37             | 0.20                           | 0.30              | 0.30                          | 0.18                          | 0.16            | 0.30            | 0.15                          | 0.10                          | NA                              |
| BCF <sub>4</sub>                | NA              | 0.21                          | 0.076            | 0.060                          | 0.0291            | 0.21                          | 0.045                         | 0.044           | 0.033           | 0.059                         | 0.11                          | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | 0.058           | NA                            | 0.058            | 0.043                          | 0.009             | 0.018                         | 0.027                         | 0.045           | 0.041           | 0.062                         | 0.083                         | NA                              |
| BC <sub>4</sub> F <sub>8</sub>  | 0.0046          | NA                            | 0.0027           | 0.054                          | 0.0070            | NA                            | NA                            | NA              | NA              | 0.0051                        | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | 0.00012                       | NA                              |
| BCHF <sub>3</sub>               | 0.012           | NA                            | NA               | 0.057                          | 0.016             | 0.012                         | 0.028                         | 0.023           | 0.0039          | 0.017                         | 0.0069                        | NA                              |
| BCH <sub>2</sub> F <sub>2</sub> | 0.005           | NA                            | 0.0024           | NA                             | 0.0033            | NA                            | 0.0021                        | 0.00074         | 0.000020        | 0.000030                      | NA                            | NA                              |
| BCH <sub>3</sub> F              | 0.0061          | NA                            | 0.027            | 0.0036                         | NA                | 0.00073                       | 0.0063                        | 0.0080          | 0.0082          | 0.00065                       | NA                            | NA                              |
| CHAMBER CLEANING                |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| IN SITU PLASMA CLEANING         |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.20            | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.037           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| REMOTE PLASMA CLEANING          |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | NA              | NA                            | NA               | NA                             | NA                | 0.063                         | NA                            | 0.018           | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.037           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BCHF <sub>3</sub>               | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.000059        | NA              | NA                            | NA                            | NA                              |
| BCH <sub>2</sub> F <sub>2</sub> | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.00088         | NA              | NA                            | NA                            | NA                              |
| BCH <sub>3</sub> F              | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.0028          | NA              | NA                            | NA                            | NA                              |
| BF <sub>2</sub>                 | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.5             | NA              | NA                            | NA                            | NA                              |
| IN SITU THERMAL CLEANING        |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.28            | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.010           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |

NOTES: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.



[89 FR 31921, Apr. 25, 2024]

**Table I-5 to Subpart I of Part 98—Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ )  
and By-Product Formation Rates ( $B_{ijk}$ ) for MEMS Manufacturing**

| Process type factors                                | Process gas i   |                               |                   |                                |                               |                                 |                           |                  |                 |                                |                                |                                              |
|-----------------------------------------------------|-----------------|-------------------------------|-------------------|--------------------------------|-------------------------------|---------------------------------|---------------------------|------------------|-----------------|--------------------------------|--------------------------------|----------------------------------------------|
|                                                     | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub>  | CH <sub>2</sub> F <sub>2</sub> | C <sub>3</sub> F <sub>8</sub> | c-C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub><br>Remote | NF <sub>3</sub>  | SF <sub>6</sub> | C <sub>4</sub> F <sub>6a</sub> | C <sub>5</sub> F <sub>8a</sub> | C <sub>4</sub> F <sub>8</sub> O <sub>a</sub> |
| Etch 1-U <sub>i</sub>                               | 0.7             | <sup>1</sup> 0.4              | <sup>1</sup> 0.4  | <sup>1</sup> 0.06              | NA                            | <sup>1</sup> 0.2                | NA                        | 0.2              | 0.2             | 0.1                            | 0.2                            | NA                                           |
| Etch BCF <sub>4</sub>                               | NA              | <sup>1</sup> 0.4              | <sup>1</sup> 0.07 | <sup>1</sup> 0.08              | NA                            | 0.2                             | NA                        | NA               | NA              | <sup>1</sup> 0.3               | 0.2                            | NA                                           |
| Etch BC <sub>2</sub> F <sub>6</sub>                 | NA              | NA                            | NA                | NA                             | NA                            | 0.2                             | NA                        | NA               | NA              | <sup>1</sup> 0.2               | 0.2                            | NA                                           |
| CVD Chamber Cleaning 1-U <sub>i</sub>               | 0.9             | 0.6                           | NA                | NA                             | 0.4                           | 0.1                             | 0.02                      | 0.2              | NA              | NA                             | 0.1                            | 0.1                                          |
| CVD Chamber Cleaning BCF <sub>4</sub>               | NA              | 0.1                           | NA                | NA                             | 0.1                           | 0.1                             | <sup>2</sup> 0.02         | <sup>2</sup> 0.1 | NA              | NA                             | 0.1                            | 0.1                                          |
| CVD Chamber Cleaning BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA                | NA                             | NA                            | NA                              | NA                        | NA               | NA              | NA                             | NA                             | 0.4                                          |

NOTES: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

<sup>1</sup> Estimate includes multi-gas etch processes.

<sup>2</sup> Estimate reflects presence of low-k, carbide and multi-gas etch processes that may contain a C-containing fluorinated GHG additive.

[75 FR 74818, Dec. 1, 2010, as amended at 78 FR 68225, Nov. 13, 2013]

**Table I-6 to Subpart I of Part 98—Default Emission Factors  $(1-U_{ij})$  for Gas Utilization Rates  $(U_{ij})$   
and By-Product Formation Rates  $(B_{ijk})$  for LCD Manufacturing**

| Process type factors                  | Process gas i   |                               |                  |                                |                               |                                  |                           |                 |                 |
|---------------------------------------|-----------------|-------------------------------|------------------|--------------------------------|-------------------------------|----------------------------------|---------------------------|-----------------|-----------------|
|                                       | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>3</sub> F <sub>8</sub> | c- C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub><br>Remote | NF <sub>3</sub> | SF <sub>6</sub> |
| Etch 1-U <sub>i</sub>                 | 0.6             | NA                            | 0.2              | NA                             | NA                            | 0.1                              | NA                        | NA              | 0.3             |
| Etch BCF <sub>4</sub>                 | NA              | NA                            | 0.07             | NA                             | NA                            | 0.009                            | NA                        | NA              | NA              |
| Etch BCHF <sub>3</sub>                | NA              | NA                            | NA               | NA                             | NA                            | 0.02                             | NA                        | NA              | NA              |
| Etch BC <sub>2</sub> F <sub>4</sub>   | NA              | NA                            | 0.05             | NA                             | NA                            | NA                               | NA                        | NA              | NA              |
| CVD Chamber Cleaning 1-U <sub>i</sub> | NA              | NA                            | NA               | NA                             | NA                            | NA                               | 0.03                      | 0.3             | 0.9             |

NOTES: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

[75 FR 74818, Dec. 1, 2010, as amended at 78 FR 68225, Nov. 13, 2013]

**Table I-7 To Subpart I of Part 98—Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for PV Manufacturing**

| Process type factors                  | Process gas i   |                               |                  |                                |                               |                                  |                           |                 |                 |
|---------------------------------------|-----------------|-------------------------------|------------------|--------------------------------|-------------------------------|----------------------------------|---------------------------|-----------------|-----------------|
|                                       | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>3</sub> F <sub>8</sub> | c- C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub><br>Remote | NF <sub>3</sub> | SF <sub>6</sub> |
| Etch 1-U <sub>i</sub>                 | 0.7             | 0.4                           | 0.4              | NA                             | NA                            | 0.2                              | NA                        | NA              | 0.4             |
| Etch BCF <sub>4</sub>                 | NA              | 0.2                           | NA               | NA                             | NA                            | 0.1                              | NA                        | NA              | NA              |
| Etch BC <sub>2</sub> F <sub>6</sub>   | NA              | NA                            | NA               | NA                             | NA                            | 0.1                              | NA                        | NA              | NA              |
| CVD Chamber Cleaning 1-U <sub>i</sub> | NA              | 0.6                           | NA               | NA                             | 0.1                           | 0.1                              | NA                        | 0.3             | 0.4             |
| CVD Chamber Cleaning BCF <sub>4</sub> | NA              | 0.2                           | NA               | NA                             | 0.2                           | 0.1                              | NA                        | NA              | NA              |

NOTES: NA = Not applicable; i.e., there are no applicable default emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

[75 FR 74818, Dec. 1, 2010, as amended at 78 FR 68225, Nov. 13, 2013]

**Table I-8 to Subpart I of Part 98—Default Emission Factors (1-UN<sub>2</sub>O<sub>j</sub>) for N<sub>2</sub>O Utilization (UN<sub>2</sub>O<sub>j</sub>)**

**TABLE I-8 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS (1-UN<sub>2</sub> O<sub>j</sub>)  
FOR N<sub>2</sub> O UTILIZATION (UN<sub>2</sub> O<sub>j</sub>)**

| Manufacturing type/process type/wafer size   | N <sub>2</sub> O |
|----------------------------------------------|------------------|
| Semiconductor Manufacturing:                 |                  |
| 200 mm or Less:                              |                  |
| CVD 1-U <sub>i</sub>                         | 1.0              |
| Other Manufacturing Process 1-U <sub>i</sub> | 1.0              |
| 300 mm or greater:                           |                  |
| CVD 1-U <sub>i</sub>                         | 0.5              |
| Other Manufacturing Process 1-U <sub>i</sub> | 1.0              |
| LCD Manufacturing:                           |                  |
| CVD Thin Film Manufacturing 1-U <sub>i</sub> | 0.63             |
| All other N <sub>2</sub> O Processes         | 1.0              |

[89 FR 31921, Apr. 25, 2024]

**Table I-9 to Subpart I of Part 98—Methods and Procedures for Conducting Emissions Test for Stack Systems**



**Table I-9 to Subpart I of Part 98—Methods and Procedures for Conducting Emissions Tests for Stack Systems**

| For each stack system for which you use the "stack test method" to calculate annual emissions... | You must...                                                       | Using...                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| For each fluorinated GHG                                                                         | Measure the concentration in the stack system.                    | Method 320 at 40 CFR part 63, appendix A or ASTM D6348-03 <sup>a</sup> (incorporated by reference, see § 98.7). Conduct the test run for a minimum of 8 hours for each stack system. |
|                                                                                                  | Select sampling port locations and the number of traverse points. | Method 1 or 1A at 40 CFR part 60, appendix A-1.                                                                                                                                      |
|                                                                                                  | Determine gas velocity and volumetric flow rate.                  | Method 2, 2A, 2C, 2D, 2F, or 2G at 40 CFR part 60, appendix A-1 and A-2.                                                                                                             |
|                                                                                                  | Determine gas molecular weight.                                   | Method 3, 3A, or 3B at 40 CFR part 60, appendix A-2 using the same sampling site and time as fluorinated GHG sampling.                                                               |
|                                                                                                  | Measure gas moisture content.                                     | Method 4 at 40 CFR part 60, appendix A-3, or using FTIR <sup>b</sup> .                                                                                                               |

<sup>a</sup> Reporters may use ASTM D6348-03 (incorporated by reference, see § 98.7) as an alternative to Method 320 at 40 CFR part 63, appendix A, with the following additional requirements: (1) The test plan preparation and implementation in the Annexes to ASTM D6348-03, Sections A1 through A8 are mandatory; and (2) In ASTM D6348-03 Annex A5 (Analyte Spiking Technique), the percent recovery (%R) must be determined for each target analyte (Equation A5.5). The reporter must also follow Section 4.1 of ASTM D6348-03 to ensure F-GHG remain in the gas phase. In order for the test data to be acceptable for a compound, the percent recovery must be between 70 and 130 percent. If the percent recovery does not meet this criterion for a target compound, the test data are not acceptable for that compound and the test must be repeated for that analyte (i.e., the sampling and/or analytical procedure should be adjusted before a retest). The percent recovery value for each compound must be reported in the test report, required under 40 CFR 98.94(j)(4), and all field measurements must be corrected with the calculated percent recovery value for that compound by using the following equation: Reported Result = Measured Concentration in the stack x (100/% R).

<sup>b</sup> Extractive FTIR is an acceptable method, in lieu of Method 4 at 40 CFR part 60 appendix A, of determining the volumetric concentrations of moisture in semiconductor stack gas streams. The spectral calibrations employed should bracket the anticipated range of optical depths (H<sub>2</sub>O concentration in parts per million multiplied by FTIR sample cell path length) measured in the field for moisture saturated (relative humidity approximately 100 percent) air streams at temperatures characterized via Method 2 at 40 CFR part 60 appendix A, within the stack. The HITRAN molecular spectroscopic database is an

example of a widely used international standard of IR absorption parameters that provide accurate H<sub>2</sub>O FTIR calibrations at atmospheric conditions. Field measurements should be verified to be in line with moisture saturated wet scrubber exhaust concentrations at measured temperatures. Field measurements at saturated conditions should be verified to be consistent with published water vapor pressure curves at the current stack temperatures (Perry, R.H. and D.W. Green. Perry’s Chemical Engineer’s Handbook (8<sup>th</sup> Edition). McGraw-Hill Publishing Company, Inc. New York, New York. 2008). For unsaturated conditions, field measurements should be verified using a single point verification of the FTIR moisture reading using Method 4 at 40 CFR part 60 appendix A, or a NIST traceable hygrometer accurate to +/- 2 percent relative humidity. The FTIR moisture reading shall agree within 10 percent of the moisture measurement obtained using Method 4 at 40 CFR part 60 appendix A or a NIST traceable hygrometer.

[78 FR 68227, Nov. 13, 2013]

**Table I-10 to Subpart I of Part 98—Maximum Field Detection Limits Applicable to Fluorinated GHG Concentration Measurements for Stack Systems**

| Fluorinated GHG Analyte         | Maximum field detection limit (ppbv) |
|---------------------------------|--------------------------------------|
| CF <sub>4</sub>                 | 20                                   |
| C <sub>2</sub> F <sub>6</sub>   | 20                                   |
| C <sub>3</sub> F <sub>8</sub>   | 20                                   |
| C <sub>4</sub> F <sub>6</sub>   | 20                                   |
| C <sub>5</sub> F <sub>8</sub>   | 20                                   |
| c-C <sub>4</sub> F <sub>8</sub> | 20                                   |
| CH <sub>2</sub> F <sub>2</sub>  | 40                                   |
| CH <sub>3</sub> F               | 40                                   |
| CHF <sub>3</sub>                | 20                                   |
| NF <sub>3</sub>                 | 20                                   |
| SF <sub>6</sub>                 | 4                                    |
| Other fully fluorinated GHGs    | 20                                   |
| Other fluorinated GHGs          | 40                                   |

ppbv—Parts per billion by volume.

[78 FR 68228, Nov. 13, 2013]

**Table I-11 to Subpart I of Part 98—Default Emission Factors (1-U<sub>ij</sub>) for Gas Utilization Rates (U<sub>ij</sub>) and By-Product Formation Rates (B<sub>ijk</sub>) for Semiconductor Manufacturing for Use With the Stack Test Method**

**TABLE I-11 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS (1-U<sub>IJ</sub>) FOR GAS UTILIZATION RATES (U<sub>IJ</sub>) AND BY-PRODUCT FORMATION RATES (B<sub>IJK</sub>) FOR SEMICONDUCTOR MANUFACTURING FOR USE WITH THE STACK TEST METHOD  
[150 MM AND 200 MM WAFERS]**

| All processes                  | Process gas i   |                               |                  |                                |                                |                   |                               |                               |                 |                           |                 |                               |                               |                                 |
|--------------------------------|-----------------|-------------------------------|------------------|--------------------------------|--------------------------------|-------------------|-------------------------------|-------------------------------|-----------------|---------------------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|                                | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>2</sub> HF <sub>5</sub> | CH <sub>3</sub> F | C <sub>3</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | NF <sub>3</sub><br>Remote | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| 1-U <sub>i</sub>               | 0.79            | 0.55                          | 0.51             | 0.13                           | 0.064                          | 0.70              | 0.40                          | 0.12                          | 0.18            | 0.028                     | 0.58            | 0.083                         | 0.072                         | 0.14                            |
| BCF <sub>4</sub>               | NA              | 0.19                          | 0.085            | 0.079                          | 0.077                          | NA                | 0.20                          | 0.11                          | 0.11            | 0.015                     | 0.13            | 0.095                         | NA                            | 0.13                            |
| BC <sub>2</sub> F <sub>6</sub> | 0.027           | NA                            | 0.035            | 0.025                          | 0.024                          | 0.0034            | NA                            | 0.019                         | 0.0059          | NA                        | 0.10            | 0.073                         | 0.014                         | 0.045                           |
| BC <sub>4</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA                        | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA                        | NA              | NA                            | NA                            | NA                              |
| BC <sub>5</sub> F <sub>8</sub> | 0.00077         | NA                            | 0.0012           | NA                             | NA                             | NA                | NA                            | 0.0043                        | NA              | NA                        | NA              | NA                            | NA                            | NA                              |
| BCHF <sub>3</sub>              | 0.060           | 0.0020                        | NA               | 0.049                          | NA                             | NA                | NA                            | 0.020                         | NA              | NA                        | 0.0011          | 0.066                         | 0.0039                        | NA                              |
| BF <sub>2</sub>                | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | 0.50                      | NA              | NA                            | NA                            | NA                              |

NOTES: NA = Not applicable; i.e., there are no applicable emission factor measurements for this gas. This does not necessarily imply that a particular gas is not used in or emitted from a particular process sub-type or process type.

[89 FR 31921, Apr. 25, 2024]

**Table I-12 to Subpart I of Part 98—Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor Manufacturing for Use With the Stack Test Method**

**TABLE I-12 TO SUBPART I OF PART 98—DEFAULT EMISSION FACTORS (1-U<sub>IJ</sub>) FOR GAS UTILIZATION RATES (U<sub>IJ</sub>) AND BY-PRODUCT FORMATION RATES (B<sub>IJK</sub>) FOR SEMICONDUCTOR MANUFACTURING FOR USE WITH THE STACK TEST METHOD  
[300 MM AND 450 MM WAFERS]**

| All processes                   | Process gas i   |                               |                  |                                |                   |                               |                                      |                               |                 |                        |                 |                               |                               |                                 |
|---------------------------------|-----------------|-------------------------------|------------------|--------------------------------|-------------------|-------------------------------|--------------------------------------|-------------------------------|-----------------|------------------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|                                 | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | CH <sub>3</sub> F | C <sub>3</sub> F <sub>8</sub> | C <sub>3</sub> F <sub>8</sub> Remote | C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | NF <sub>3</sub> Remote | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| 1-U <sub>i</sub>                | 0.65            | 0.80                          | 0.37             | 0.20                           | 0.30              | 0.30                          | 0.063                                | 0.183                         | 0.19            | 0.018                  | 0.30            | 0.15                          | 0.100                         | NA                              |
| BCF <sub>4</sub>                | NA              | 0.21                          | 0.076            | 0.060                          | 0.029             | 0.21                          | NA                                   | 0.045                         | 0.040           | 0.037                  | 0.033           | 0.059                         | 0.109                         | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | 0.058           | NA                            | 0.058            | 0.043                          | 0.0093            | 0.18                          | NA                                   | 0.027                         | 0.0204          | NA                     | 0.041           | 0.062                         | 0.083                         | NA                              |
| BC <sub>4</sub> F <sub>6</sub>  | 0.0083          | NA                            | 0.01219          | NA                             | 0.001             | NA                            | NA                                   | 0.008                         | NA              | NA                     | NA              | NA                            | NA                            | NA                              |
| BC <sub>4</sub> F <sub>8</sub>  | 0.0046          | NA                            | 0.00272          | 0.054                          | 0.007             | NA                            | NA                                   | NA                            | NA              | NA                     | NA              | 0.0051                        | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                                   | NA                            | NA              | NA                     | NA              | NA                            | 0.00012                       | NA                              |
| BCH <sub>2</sub> F <sub>2</sub> | 0.005           | NA                            | 0.0024           | NA                             | 0.0033            | NA                            | NA                                   | 0.0021                        | 0.00034         | 0.00088                | 0.000020        | 0.000030                      | NA                            | NA                              |
| BCH <sub>3</sub> F              | 0.0061          | NA                            | 0.027            | 0.0036                         | NA                | 0.0007                        | NA                                   | 0.0063                        | 0.0036          | 0.0028                 | 0.0082          | 0.00065                       | NA                            | NA                              |
| BCHF <sub>3</sub>               | 0.012           | NA                            | NA               | 0.057                          | 0.016             | 0.012                         | NA                                   | 0.028                         | 0.0106          | 0.000059               | 0.0039          | 0.017                         | 0.0069                        | NA                              |
| BF <sub>2</sub>                 | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                                   | NA                            | NA              | 0.50                   | NA              | NA                            | NA                            | NA                              |

*[89 FR 31922, Apr. 25, 2024]*  
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**Table I-13 to Subpart I of Part 98—Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for LCD Manufacturing for Use With the Stack Test Method**

Emission Factors (1–U<sub>ij</sub>) for Gas Utilization Rates (U<sub>ij</sub>) and By-Product  
for use with the Stack Test Method

| Process Gas i |                  |                                |                               |                                 |                           |                 |                 |
|---------------|------------------|--------------------------------|-------------------------------|---------------------------------|---------------------------|-----------------|-----------------|
|               | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>3</sub> F <sub>8</sub> | c-C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub><br>Remote | NF <sub>3</sub> | SF <sub>6</sub> |
|               | 0.2              | NA                             | NA                            | 0.1                             | 0.03                      | 0.3             | 0.6             |
|               | 0.07             | NA                             | NA                            | 0.009                           | NA                        | NA              | NA              |
|               | NA               | NA                             | NA                            | 0.02                            | NA                        | NA              | NA              |
|               | 0.05             | NA                             | NA                            | NA                              | NA                        | NA              | NA              |
|               | NA               | NA                             | NA                            | NA                              | NA                        | NA              | NA              |

Applicable emission factor measurements for this gas. This does not necessarily imply  
a particular process sub-type or process type.



*[78 FR 68231, Nov. 13, 2013]*

**Table I-14 to Subpart I of Part 98—Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for PV Manufacturing for Use With the Stack Test Method**

Emission Factors (1–U<sub>ij</sub>) for Gas Utilization Rates (U<sub>ij</sub>) and By-Product  
for use with the Stack Test Method

| Process Gas i |                  |                                |                               |                                 |                           |                 |                 |
|---------------|------------------|--------------------------------|-------------------------------|---------------------------------|---------------------------|-----------------|-----------------|
|               | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>3</sub> F <sub>8</sub> | c-C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub><br>Remote | NF <sub>3</sub> | SF <sub>6</sub> |
|               | 0.4              | NA                             | 0.4                           | 0.2                             | NA                        | 0.2             | 0.4             |
|               | NA               | NA                             | 0.2                           | 0.1                             | NA                        | 0.05            | NA              |
|               | NA               | NA                             | NA                            | 0.1                             | NA                        | NA              | NA              |
|               | NA               | NA                             | NA                            | NA                              | NA                        | NA              | NA              |

able emission factor measurements for this gas. This does not necessarily imply that a  
ular process sub-type or process type.

*[78 FR 68232, Nov. 13, 2013]*

**Table I-15 to Subpart I of Part 98—Default Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for MEMS Manufacturing for Use With the Stack Test Method**

Emission Factors (1–U<sub>ij</sub>) for Gas Utilization Rates (U<sub>ij</sub>) and By-Product Formation  
se with the Stack Test Method

| Process Gas i |                |                                 |                           |                 |                 |                               |                               |                                 |
|---------------|----------------|---------------------------------|---------------------------|-----------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|               | F <sub>8</sub> | c-C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub><br>Remote | NF <sub>3</sub> | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| .4            |                | 0.1                             | 0.2                       | 0.2             | 0.2             | 0.1                           | 0.1                           | 0.1                             |
| .1            |                | 0.1                             | <sup>a</sup> 0.02         | 0.09            | NA              | 0.3                           | 0.1                           | 0.1                             |
| A             |                | <sup>a</sup> 0.04               | NA                        | NA              | NA              | 0.2                           | 0.04                          | NA                              |
| A             |                | NA                              | NA                        | NA              | NA              | NA                            | NA                            | NA                              |

licable emission factor measurements for this gas. This does not necessarily imply that a  
cular process sub-type or process type.  
multi-gas etch processes that may contain a C-containing fluorinated GHG additive.

[78 FR 68233, Nov. 13, 2013]

**Table I-16 to Subpart I of Part 98—Default Emission Destruction or Removal Efficiency (DRE)  
Factors for Electronics Manufacturing**

**TABLE I-16 TO SUBPART I OF PART 98—DEFAULT EMISSION DESTRUCTION OR  
REMOVAL EFFICIENCY (DRE) FACTORS FOR ELECTRONICS MANUFACTURING**

| Manufacturing type/process type/gas                                         | Default DRE<br>(%) |
|-----------------------------------------------------------------------------|--------------------|
| MEMS, LCDs, and PV Manufacturing                                            | 60                 |
| Semiconductor Manufacturing:                                                |                    |
| CF <sub>4</sub>                                                             | 87                 |
| CH <sub>3</sub> F                                                           | 98                 |
| CHF <sub>3</sub>                                                            | 97                 |
| CH <sub>2</sub> F <sub>2</sub>                                              | 98                 |
| C <sub>4</sub> F <sub>8</sub>                                               | 93                 |
| C <sub>4</sub> F <sub>8</sub> O                                             | 93                 |
| C <sub>5</sub> F <sub>8</sub>                                               | 97                 |
| C <sub>4</sub> F <sub>6</sub>                                               | 95                 |
| C <sub>3</sub> F <sub>8</sub>                                               | 98                 |
| C <sub>2</sub> HF <sub>5</sub>                                              | 97                 |
| C <sub>2</sub> F <sub>6</sub>                                               | 98                 |
| SF <sub>6</sub>                                                             | 95                 |
| NF <sub>3</sub>                                                             | 96                 |
| All other carbon-based fluorinated GHGs used in Semiconductor Manufacturing | 60                 |
| N <sub>2</sub> O Processes                                                  |                    |
| CVD and all other N <sub>2</sub> O-using processes                          | 60                 |

[89 FR 31922, Apr. 25, 2024]

**Table I-17 to Subpart I of Part 98—Expected and Possible By-Products for Electronics Manufacturing**

| For each stack system for which you use the “stack test method” to calculate annual emissions, you must measure the following:                                                                                                                                                                                                 | If emissions are detected intermittently, use the following procedures:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | If emissions are not detected, use the following procedures:                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Expected By-products:</p> <p>CF<sub>4</sub><br/>C<sub>2</sub> F<sub>6</sub><br/>CHF<sub>3</sub><br/>CH<sub>2</sub> F<sub>2</sub><br/>CH<sub>3</sub> F</p> <p>Possible By-products:</p> <p>C<sub>3</sub> F<sub>8</sub><br/>C<sub>4</sub> F<sub>6</sub><br/>c-C<sub>4</sub> F<sub>8</sub><br/>C<sub>5</sub> F<sub>8</sub></p> | <p>Use the measured concentration for “X<sub>ksm</sub>” in Equation I-18 when available and use one-half of the field detection limit you determined for the fluorinated GHG according to § 98.94(j)(2) for the value of “X<sub>ksm</sub>” when the fluorinated GHG is not detected</p> <p>Use the measured concentration for “X<sub>ksm</sub>” in Equation I-18 when available and use one-half of the field detection limit you determined for the fluorinated GHG according to § 98.94(j)(2) for the value of “X<sub>ksm</sub>” when the fluorinated GHG is not detected</p> | <p>Use one-half of the field detection limit you determined for the fluorinated GHG according to § 98.94(j)(2) for the value of “X<sub>ksm</sub>” in Equation I-18.</p> <p>Assume zero emissions for that fluorinated GHG for the tested stack system.</p> |

[78 FR 68234, Nov. 13, 2013]

**Table I-18 to Subpart I of Part 98—Default Factors for Gamma ( $\gamma_{i,p}$  and  $\gamma_{k,i,p}$ ) for Semiconductor Manufacturing and for MEMS and PV Manufacturing Under Certain Conditions \* for Use With the Stack Testing Method**



**TABLE I-18 TO SUBPART I OF PART 98—DEFAULT FACTORS FOR GAMMA ( $G_{I,P}$  AND  $G_{K,I,P}$ ) FOR SEMICONDUCTOR MANUFACTURING AND FOR MEMS AND PV MANUFACTURING UNDER CERTAIN CONDITIONS \* FOR USE WITH THE STACK TESTING METHOD**

| Process type                                                                           | In-situ thermal or in-situ plasma cleaning |                               |                                 |                 |                 | Remote plasma cleaning        |                 |                 |
|----------------------------------------------------------------------------------------|--------------------------------------------|-------------------------------|---------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| Gas                                                                                    | CF <sub>4</sub>                            | C <sub>2</sub> F <sub>6</sub> | c-C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | SF <sub>6</sub> | C <sub>3</sub> F <sub>8</sub> | CF <sub>4</sub> | NF <sub>3</sub> |
| IF MANUFACTURING WAFER SIZES ≤200 MM AND MANUFACTURING 300 MM (OR GREATER) WAFER SIZES |                                            |                               |                                 |                 |                 |                               |                 |                 |
| $g_i$                                                                                  | 13                                         | 9.3                           | 4.7                             | 14              | 11              | NA                            | NA              | 5.7             |
| $g_{CF_4,i}$                                                                           | NA                                         | 23                            | 6.7                             | 63              | 8.7             | NA                            | NA              | 58              |
| $g_{C_2F_6,i}$                                                                         | NA                                         | NA                            | NA                              | NA              | 3.4             | NA                            | NA              | NA              |
| $g_{CHF_3,i}$                                                                          | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | 0.24            |
| $g_{CH_2F_2,i}$                                                                        | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | 111             |
| $g_{CH_3F,i}$                                                                          | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | 33              |
| IF MANUFACTURING ≤200 MM OR MANUFACTURING 300 MM (OR GREATER) WAFER SIZES              |                                            |                               |                                 |                 |                 |                               |                 |                 |
| $g_i$ (≤ 200 mm wafer size)                                                            | 13                                         | 9.3                           | 4.7                             | 2.9             | 11              | NA                            | NA              | 1.4             |
| $g_{CF_4,i}$ (≤200 mm wafer size)                                                      | NA                                         | 23                            | 6.7                             | 110             | 8.7             | NA                            | NA              | 36              |
| $g_{C_2F_6,i}$ (≤200 mm wafer size)                                                    | NA                                         | NA                            | NA                              | NA              | 3.4             | NA                            | NA              | NA              |
| $g_i$ (300 mm wafer size)                                                              | NA                                         | NA                            | NA                              | 26              | NA              | NA                            | NA              | 10              |
| $g_{CF_4,i}$ (300 mm wafer size)                                                       | NA                                         | NA                            | NA                              | 17              | NA              | NA                            | NA              | 80              |
| $g_{C_2F_6,i}$ (300 mm wafer size)                                                     | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | NA              |
| $g_{CHF_3,i}$ (300 mm wafer size)                                                      | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | 0.24            |
| $g_{CH_2F_2,i}$ (300 mm wafer size)                                                    | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | 111             |
| $g_{CH_3F,i}$ (300 mm wafer size)                                                      | NA                                         | NA                            | NA                              | NA              | NA              | NA                            | NA              | 33              |

\* If you manufacture MEMS or PVs and use semiconductor tools and processes, you may use the corresponding  $g$  in this table. For all other tools and processes, a default  $g$  of 10 must be used.

[89 FR 31922, Apr. 25, 2024]

**Table I-19 to Subpart I of Part 98—Reference Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor Manufacturing for 150 mm and 200 mm Wafer Sizes**

**TABLE I-19 TO SUBPART I OF PART 98—REFERENCE EMISSION FACTORS (1-U<sub>IJ</sub>) FOR GAS UTILIZATION RATES (U<sub>IJ</sub>) AND BY-PRODUCT FORMATION RATES (B<sub>IJK</sub>) FOR SEMICONDUCTOR MANUFACTURING FOR 150 MM AND 200 MM WAFER SIZES**

| Process type/sub-type          | Process gas i   |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
|--------------------------------|-----------------|-------------------------------|------------------|--------------------------------|--------------------------------|-------------------|-------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|                                | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | C <sub>2</sub> HF <sub>5</sub> | CH <sub>3</sub> F | C <sub>3</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| ETCHING/WAFER CLEANING         |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | 0.73            | 0.46                          | 0.31             | 0.37                           | 0.064                          | 0.66              | NA                            | 0.21                          | 0.20            | 0.55            | 0.086                         | 0.072                         | NA                              |
| BCF <sub>4</sub>               | NA              | 0.20                          | 0.10             | 0.031                          | 0.077                          | NA                | NA                            | 0.17                          | 0.0040          | 0.023           | 0.0089                        | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub> | 0.029           | NA                            | NA               | NA                             | NA                             | NA                | NA                            | 0.065                         | NA              | NA              | 0.045                         | 0.014                         | NA                              |
| BC <sub>4</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>4</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>5</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | 0.016                         | NA              | NA              | NA                            | NA                            | NA                              |
| BCHF <sub>3</sub>              | 0.13            | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | 0.0039                        | NA                              |
| CHAMBER CLEANING               |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| IN SITU PLASMA CLEANING        |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | 0.92            | 0.55                          | NA               | NA                             | NA                             | NA                | 0.40                          | 0.10                          | 0.18            | NA              | NA                            | NA                            | 0.14                            |
| BCF <sub>4</sub>               | NA              | 0.19                          | NA               | NA                             | NA                             | NA                | 0.20                          | 0.11                          | 0.14            | NA              | NA                            | NA                            | 0.13                            |
| BC <sub>2</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | 0.045                           |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| REMOTE PLASMA CLEANING         |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | 0.028           | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | 0.015           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| IN SITU THERMAL CLEANING       |                 |                               |                  |                                |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>               | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub> | NA              | NA                            | NA               | NA                             | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |

[89 FR 31923, Apr. 25, 2024]

**Table I-20 to Subpart I of Part 98—Reference Emission Factors ( $1-U_{ij}$ ) for Gas Utilization Rates ( $U_{ij}$ ) and By-Product Formation Rates ( $B_{ijk}$ ) for Semiconductor Manufacturing for 300 mm Wafer Sizes**

**TABLE I-20 TO SUBPART I OF PART 98—REFERENCE EMISSION FACTORS (1-U<sub>IJ</sub>) FOR GAS UTILIZATION RATES (U<sub>IJ</sub>)  
AND BY-PRODUCT FORMATION RATES (B<sub>IJK</sub>) FOR SEMICONDUCTOR MANUFACTURING FOR 300 MM WAFER SIZES**

| Process type/sub-type           | Process gas i   |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
|---------------------------------|-----------------|-------------------------------|------------------|--------------------------------|-------------------|-------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-------------------------------|---------------------------------|
|                                 | CF <sub>4</sub> | C <sub>2</sub> F <sub>6</sub> | CHF <sub>3</sub> | CH <sub>2</sub> F <sub>2</sub> | CH <sub>3</sub> F | C <sub>3</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> | NF <sub>3</sub> | SF <sub>6</sub> | C <sub>4</sub> F <sub>6</sub> | C <sub>5</sub> F <sub>8</sub> | C <sub>4</sub> F <sub>8</sub> O |
| ETCHING/WAFER CLEANING          |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | 0.68            | 0.80                          | 0.35             | 0.15                           | 0.34              | 0.30                          | 0.16                          | 0.17            | 0.28            | 0.17                          | 0.10                          | NA                              |
| BCF <sub>4</sub>                | NA              | 0.21                          | 0.073            | 0.020                          | 0.038             | 0.21                          | 0.045                         | 0.035           | 0.0072          | 0.034                         | 0.11                          | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | 0.041           | NA                            | 0.040            | 0.0065                         | 0.0064            | 0.18                          | 0.030                         | 0.038           | 0.0017          | 0.025                         | 0.083                         | NA                              |
| BC <sub>4</sub> F <sub>6</sub>  | 0.0015          | NA                            | 0.00010          | NA                             | 0.0010            | NA                            | 0.00083                       | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>4</sub> F <sub>8</sub>  | 0.0051          | NA                            | 0.00061          | NA                             | 0.0070            | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | 0.00012                       | NA                              |
| BC <sub>5</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BCHF <sub>3</sub>               | 0.0056          | NA                            | NA               | 0.033                          | 0.0049            | 0.012                         | 0.029                         | 0.0065          | 0.0012          | 0.019                         | 0.0069                        | NA                              |
| BCH <sub>2</sub> F <sub>2</sub> | 0.014           | NA                            | 0.0026           | NA                             | 0.0023            | NA                            | 0.0014                        | 0.00086         | 0.000020        | 0.000030                      | NA                            | NA                              |
| BCH <sub>3</sub> F              | 0.00057         | NA                            | 0.12             | NA                             | NA                | 0.00073                       | NA                            | NA              | 0.0082          | NA                            | NA                            | NA                              |
| CHAMBER CLEANING                |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| IN SITU PLASMA CLEANING         |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.20            | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.037           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| REMOTE PLASMA CLEANING          |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | NA              | NA                            | NA               | NA                             | NA                | 0.063                         | NA                            | 0.018           | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.038           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BCHF <sub>3</sub>               | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.000059        | NA              | NA                            | NA                            | NA                              |
| BCH <sub>2</sub> F <sub>2</sub> | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.0016          | NA              | NA                            | NA                            | NA                              |
| BCH <sub>3</sub> F              | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.0028          | NA              | NA                            | NA                            | NA                              |
| IN SITU THERMAL CLEANING        |                 |                               |                  |                                |                   |                               |                               |                 |                 |                               |                               |                                 |
| 1-U <sub>i</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.28            | NA              | NA                            | NA                            | NA                              |
| BCF <sub>4</sub>                | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | 0.010           | NA              | NA                            | NA                            | NA                              |
| BC <sub>2</sub> F <sub>6</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |
| BC <sub>3</sub> F <sub>8</sub>  | NA              | NA                            | NA               | NA                             | NA                | NA                            | NA                            | NA              | NA              | NA                            | NA                            | NA                              |

[89 FR 31923, Apr. 25, 2024]

Table I-21 to Subpart I of Part 98—Examples of Fluorinated GHGs Used by the Electronics Industry

TABLE I-21 TO SUBPART I OF PART 98—EXAMPLES OF FLUORINATED GHGs USED BY THE ELECTRONICS INDUSTRY

| Product type | Fluorinated GHGs used during manufacture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Electronics  | CF <sub>4</sub> , C <sub>2</sub> F <sub>6</sub> , C <sub>3</sub> F <sub>8</sub> , c-C <sub>4</sub> F <sub>8</sub> , c-C <sub>4</sub> F <sub>8</sub> O, C <sub>4</sub> F <sub>6</sub> , C <sub>5</sub> F <sub>8</sub> , CHF <sub>3</sub> , CH <sub>2</sub> F <sub>2</sub> , NF <sub>3</sub> , SF <sub>6</sub> , and fluorinated HTFs (CF <sub>3</sub> -(O-CF(CF <sub>3</sub> )-CF <sub>2</sub> ) <sub>n</sub> -(O-CF <sub>2</sub> ) <sub>m</sub> -O-CF <sub>3</sub> , C <sub>n</sub> F <sub>2n+2</sub> , C <sub>n</sub> F <sub>2n+1</sub> (O)C <sub>m</sub> F <sub>2m+1</sub> , C <sub>n</sub> F <sub>2n</sub> O, (C <sub>n</sub> F <sub>2n+1</sub> ) <sub>3N</sub> ). |

[89 FR 31924, Apr. 25, 2024.]

Appendix A to Subpart I of Part 98—Alternative Procedures for Measuring Point-of-Use Abatement Device Destruction or Removal Efficiency

If you are measuring destruction or removal efficiency of a point-of-use abatement device according to EPA 430-R-10-003 (incorporated by reference, see § 98.7) as specified in § 98.94(f)(4), you may follow the alternative procedures specified in paragraphs (a) through (c) of this appendix.

- (a) In place of the Quadrupole Mass Spectrometry protocol requirements specified in section 2.2.4 of EPA 430-R-10-003 (incorporated by reference, see § 98.7), you must conduct mass spectrometry testing in accordance with the provisions in paragraph (a)(1) through (a)(15) of this appendix.
- (1)

**Detection limits.** The mass spectrometer chosen for this application must have the necessary sensitivity to detect the selected effluent species at or below the maximum field detection limits specified in Table 3 of section 2.2.7 of EPA 430-R-10-003 (incorporated by reference, see § 98.7).
- (2)

**Sampling location.** The sample at the inlet of the point-of-use abatement device must be taken downstream of the process tool and pump package. The sample exhaust must be vented back into the corrosive house ventilation system at a point downstream of the sample inlet location.
- (3)

**Sampling conditions.** For etch processes, destruction or removal efficiencies must be determined while etching a substrate (product, dummy, or test). For chemical vapor deposition processes, destruction or removal efficiencies must be determined during a chamber clean after deposition (destruction or removal efficiencies must not be determined in a clean chamber). All sampling must be performed non-intrusively during wafer processing. Samples must be drawn through the mass spectrometer source by an external sample pump. Because of the volatility, vapor pressure, stability and inertness of CF<sub>4</sub>, C<sub>2</sub>F<sub>6</sub>, C<sub>3</sub>F<sub>8</sub>, CHF<sub>3</sub>, NF<sub>3</sub>, and SF<sub>6</sub>, the sample lines do not need to be heated.

- (4) Mass spectrometer parameters. The specific mass spectrometer operating conditions such as electron energy, secondary electron multiplier voltage, emission current, and ion focusing voltage must be selected according to the specifications provided by the mass spectrometer manufacturer, the mass spectrometer system manual, basic mass spectrometer textbook, or other such sources. The mass spectrometer responses to each of the target analytes must all be calibrated under the same mass spectrometer operating conditions.
- (5) **Flow rates.** A sample flow rate of 0.5-1.5 standard liters per minute (slm) must be drawn from the process tool exhaust stream under study.
- (6) **Sample frequency.** The mass spectrometer sampling frequency for etch processes must be in the range of 0.5 to 1 cycles per second, and for chemical vapor deposition processes must be in the range of 0.25 to 0.5 cycles per second. As an alternative you may use the sampling frequencies specified in section 2.2.4 of EPA 430-R-10-003 (incorporated by reference, see § 98.7).
- (7) **Dynamic dilution calibration parameters.** The quadrupole mass spectrometer must be calibrated for both mass location and response to analytes. A dynamic dilution calibration system may be used to perform both types of mass spectrometer system calibrations using two mass flow controllers. Use one mass flow controller to regulate the flow rate of the standard component used to calibrate the system and the second mass flow controller to regulate the amount of diluent gas used to mix with the standard to generate the calibration curve for each compound of interest. The mass flow controller must be calibrated using the single component gas being used with them, for example, nitrogen (N<sub>2</sub>) for the diluent. A mass flow controller used with calibration mixtures must be calibrated with the calibration mixture balance gas (for example, N<sub>2</sub> or He) if the analyte components are 2 percent or less of the volume of the sample. All calibration mixtures must be National Institute of Standards and Technology Traceable gases or equivalent. They must be calibrated over their range of use and must be operated in their experimentally determined dynamic linear range. If compressed gas standards cannot be brought into the fab, metered gas flows of target compounds into the process chamber, under no thermal or plasma conditions and with no wafer(s) present, and with no process emissions from other tools contributing to the sample location, must then be performed throughout the appropriate concentration ranges to derive calibration curves for the subsequent destruction or removal efficiency tests.
- (8) **Mass location calibration.** A mixture containing 1 percent He, Ar, Kr, and Xe in a balance gas of nitrogen must be used to assure the alignment of the quadrupole mass filter (see EPA Method 205 at 40 CFR part 51, appendix M as reference). The mass spectrometer must be chosen so that the mass range is sufficient to detect the predominant peaks of the components under study.
- (9) **Quadrupole mass spectrometer response calibration.** A calibration curve must be generated for each compound of interest.
- (10) **Calibration frequency.** The mass spectrometer must be calibrated at the start of testing a given process. The calibration must be checked at the end of testing.
- (11) **Calibration range.** The mass spectrometer must be calibrated over the expected concentration range of analytes using a minimum of five concentrations including a zero. The zero point is defined as diluent containing no added analyte.
- (12) **Operating procedures.** You must follow the operating procedures specified in paragraphs (a)(12)(i) through (v) of this appendix.

- (i) You must perform a qualitative mass calibration by running a standard (or by flowing chamber gases under non-process conditions) containing stable components such as Ar, Kr, and Xe that provide predominant signals at m/e values distributed throughout the mass range to be used. You must adjust the quadrupole mass filter as needed to align with the inert gas fragments.
  - (ii) You must quantitatively calibrate the quadrupole mass spectrometer for each analyte of interest. The analyte concentrations during calibration must include the expected concentrations in the process effluent. The calibration must be performed under the same operating conditions, such as inlet pressure, as when sampling process exhaust. If the calibration inlet pressure differs from the sampling inlet pressure then the relationship between inlet pressure and quadrupole mass spectrometer signal response must be empirically determined and applied to correct for any differences between calibration and process emissions monitoring data.
  - (iii) To determine the response time of the instrument to changes in a process, a process gas such as C<sub>2</sub>F<sub>6</sub> must be turned on at the process tool for a fixed period of time (for example, 20 seconds), after which the gas is shut off. The sample flow rate through the system must be adjusted so that the signal increases to a constant concentration within a few seconds and decreases to background levels also within a few seconds.
  - (iv) You must sample the process effluent through the quadrupole mass spectrometer and acquire data for the required amount of time to track the process, as determined in paragraph (a)(12)(iii) of this appendix. You must set the sample frequency to monitor the changes in the process as specified in paragraph (a)(6) of this appendix. You must repeat this for at least five substrates on the same process and calculate the average and standard deviation of the analyte concentration.
  - (v) You must repeat the quantitative calibration at the conclusion of sampling to identify any drifts in quadrupole mass spectrometer sensitivity. If drift is observed, you must use an internal standard to correct for changes in sensitivity.
- (13) **Sample analysis.** To determine the concentration of a specific component in the sample, you must divide the ion intensity of the sample response by the calibrated response factor for each component.
- (14) **Deconvolution of interfering peaks.** The effects of interfering peaks must be deconvoluted from the mass spectra for each target analyte.
- (15) **Calculations.** Plot ion intensity versus analyte concentration for a given compound obtained when calibrating the analytical system. Determine the slope and intercept for each calibrated species to obtain response factors with which to calculate concentrations in the sample. For an acceptable calibration, the R<sup>2</sup> value of the calibration curve must be at least 0.98.
- (b) In place of the Fourier Transform Infrared Spectroscopy protocol requirements specified in section 2.2.4 of EPA 430-R-10-003 (incorporated by reference, see § 98.7), you may conduct Fourier Transform Infrared Spectroscopy testing in accordance with the provisions in paragraph (b)(1) through (17) of this appendix, including the laboratory study phase described in paragraphs (b)(1) through (7), and the field study phase described in paragraphs (b)(8) through (17) of this appendix.
- (1) **Conformance with provisions associated with the Calibration Transfer Standard.** This procedure calls for the use of a calibration transfer standard in a number of instances. The use of a calibration transfer standard is necessary to validate optical pathlength and detector response for



spectrometers where cell temperature, cell pressure, and cell optical pathlength are potentially variable. For fixed pathlength spectrometers capable of controlling cell temperature and pressure to within  $\pm 10$  percent of a desired set point, the use of a calibration transfer standard, as described in paragraphs (b)(2) to (17) this appendix is not required.

- (2) **Defining spectroscopic conditions.** Define a set of spectroscopic conditions under which the field studies and subsequent field applications are to be carried out. These include the minimum instrumental line-width, spectrometer wave number range, sample gas temperature, sample gas pressure, absorption pathlength, maximum sampling system volume (including the absorption cell), minimum sample flow rate, and maximum allowable time between consecutive infrared analyses of the effluent.
- (3) **Criteria for reference spectral libraries.** On the basis of previous emissions test results and/or process knowledge (including the documentation of results of any initial and subsequent tests, and the final reports required in § 98.97(d)(4)(i)), estimate the maximum concentrations of all of the analytes in the effluent and their minimum concentrations of interest (those concentrations below which the measurement of the compounds is of no importance to the analysis). Values between the maximum expected concentration and the minimum concentration of interest are referred to below as the "expected concentration range." A minimum of three reference spectra is sufficient for a small expected concentration range (e.g., a difference of 30 percent of the range between the low and high ends of the range), but a minimum of four spectra are needed where the range is greater, especially for concentration ranges that may differ by orders of magnitude. If the measurement method is not linear then multiple linear ranges may be necessary. If this approach is adopted, then linear range must be demonstrated to pass the required quality control. When the set of spectra is ordered according to absorbance, the absorbance levels of adjacent reference spectra should not differ by more than a factor of six. Reference spectra for each analyte should be available at absorbance levels that bracket the analyte's expected concentration range; minimally, the spectrum whose absorbance exceeds each analyte's expected maximum concentration or is within 30 percent of it must be available. The reference spectra must be collected at or near the same temperature and pressure at which the sample is to be analyzed under. The gas sample pressure and temperature must be continuously monitored during field testing and you must correct for differences in temperature and pressure between the sample and reference spectra. Differences between the sample and reference spectra conditions must not exceed 50 percent for pressure and 40 °C for temperature.
- (4) **Spectra without reference libraries.** If reference spectral libraries meeting the criteria in paragraph (b)(3) of this appendix do not exist for all the analytes and interferants or cannot be accurately generated from existing libraries exhibiting lower minimum instrumental line-width values than those proposed for the testing, prepare the required spectra according to the procedures specified in paragraphs (b)(4)(i) and (ii) of this appendix.
  - (i) Reference spectra at the same absorbance level (to within 10 percent) of independently prepared samples must be recorded. The reference samples must be prepared from neat forms of the analyte or from gas standards of the highest quality commonly available from commercial sources. Either barometric or volumetric methods may be used to dilute the reference samples to the required concentrations, and the equipment used must be independently calibrated to ensure suitable accuracy. Dynamic and static reference sample preparation methods are acceptable, but dynamic preparations must be used for reactive

analytes. Any well characterized absorption pathlength may be employed in recording reference spectra, but the temperature and pressure of the reference samples should match as closely as possible those of the proposed spectroscopic conditions.

- (ii) If a mercury cadmium telluride or other potentially non-linear detector (i.e., a detector whose response vs. total infrared power is not a linear function over the range of responses employed) is used for recording the reference spectra, you must correct for the effects of this type of response on the resulting concentration values. As needed, spectra of a calibration transfer standard must be recorded with the laboratory spectrometer system to verify the absorption pathlength and other aspects of the system performance. All reference spectral data must be recorded in interferometric form and stored digitally.
- (5) **Sampling system preparation.** Construct a sampling system suitable for delivering the proposed sample flow rate from the effluent source to the infrared absorption cell. For the compounds of interest, the surfaces of the system exposed to the effluent stream may need to be stainless steel or Teflon; because of the potential for generation of inorganic automated gases, glass surfaces within the sampling system and absorption cell may need to be Teflon-coated. The sampling system should be able to deliver a volume of sample that results in a necessary response time.
  - (6) **Preliminary analytical routines.** For the proposed absorption pathlength to be used in actual emissions testing, you must prepare an analysis method containing of all the effluent compounds at their expected maximum concentrations plus the field calibration transfer standard compound at 20 percent of its full concentration as needed.
  - (7) **Documentation.** The laboratory techniques used to generate reference spectra and to convert sample spectral information to compound concentrations must be documented. The required level of detail for the documentation is that which allows an independent analyst to reproduce the results from the documentation and the stored interferometric data.
  - (8) **Spectroscopic system performance.** The performance of the proposed spectroscopic system, sampling system, and analytical method must be rigorously examined during and after a field study. Several iterations of the analysis method may need to be applied depending on observed concentrations, absorbance intensities, and interferences. During the field study, all the sampling and analytical procedures envisioned for future field applications must be documented. Additional procedures not required during routine field applications, notably dynamic spiking studies of the analyte gases, may be performed during the field study. These additional procedures need to be performed only once if the results are acceptable and if the effluent sources in future field applications prove suitably similar to those chosen for the field study. If changes in the effluent sources in future applications are noted and require substantial changes to the analytical equipment and/or conditions, a separate field study must be performed for the new set of effluent source conditions. All data recorded during the study must be retained and documented, and all spectral information must be permanently stored in interferometric form.
  - (9) **System installation.** The spectroscopic and sampling sub-systems must be assembled and installed according to the manufacturers' recommendations. For the field study, the length of the sample lines used must not be less than the maximum length envisioned for future field applications. The system must be given sufficient time to stabilize before testing begins.
  - (10) **Pre-Test calibration.** Record a suitable background spectrum using pure nitrogen gas; alternatively, if the analytes of interest are in a sample matrix consistent with ambient air, it is beneficial to use an ambient air background to control interferences from water and carbon dioxide. For variable

pathlength Fourier Transform Infrared Spectrometers, introduce a sample of the calibration transfer standard gas directly into the absorption cell at the expected sample pressure and record its absorbance spectrum (the "initial field calibration transfer standard spectrum"). Compare it to the laboratory calibration transfer standard spectra to determine the effective absorption pathlength. If possible, record spectra of field calibration gas standards (single component standards of the analyte compounds) and determine their concentrations using the reference spectra and analytical routines developed in paragraphs (b)(2) through (7) of this appendix; these spectra may be used instead of the reference spectra in actual concentration and uncertainty calculations.

- (11) **Deriving the calibration transfer standard gas from tool chamber gases.** The calibration transfer standard gas may be derived by flowing appropriate semiconductor tool chamber gases under non-process conditions (no thermal or plasma conditions and with no wafer(s) present) if compressed gas standards cannot be brought on-site.
- (12) **Reactivity and response time checks.** While sampling ambient air and continuously recording absorbance spectra, suddenly replace the ambient air flow with calibration transfer standard gas introduced as close as possible to the probe tip. Examine the subsequent spectra to determine whether the flow rate and sample volume allow the system to respond quickly enough to changes in the sampled gas. Should a corrosive or reactive gas be of interest in the sample matrix it would be beneficial to determine the reactivity in a similar fashion, if practical. Examine the subsequent spectra to ensure that the reactivities of the analytes with the exposed surfaces of the sampling system do not limit the time response of the analytical system. If a pressure correction routine is not automated, monitor the absorption cell temperature and pressure; verify that the (absolute) pressure remains within 2 percent of the pressure specified in the proposed system conditions.
- (13) **Analyte spiking.** Analyte spiking must be performed. While sampling actual source effluent, introduce a known flow rate of calibration transfer standard gas into the sample stream as close as possible to the probe tip or between the probe and extraction line. Measure and monitor the total sample flow rate, and adjust the spike flow rate until it represents 10 percent to 20 percent of the total flow rate. After waiting until at least four absorption cell volumes have been sampled, record four spectra of the spiked effluent, terminate the calibration transfer standard spike flow, pause until at least four cell volumes are sampled, and then record four (unspiked) spectra. Repeat this process until 12 spiked and 12 unspiked spectra have been obtained. If a pressure correction routine is not automated, monitor the absorption cell temperature and pressure; verify that the pressure remains within 2 percent of the pressure specified in the proposed system conditions. Calculate the expected calibration transfer standard compound concentrations in the spectra and compare them to the values observed in the spectrum. This procedure is best performed using a spectroscopic tracer to calculate dilution (as opposed to measured flow rates) of the injected calibration transfer standard (or analyte). The spectroscopic tracer should be a component not in the gas matrix that is easily detectable and maintains a linear absorbance over a large concentration range. Repeat this spiking process with all effluent compounds that are potentially reactive with either the sampling system components or with other effluent compounds. The gas spike is delivered by a mass flow controller, and the expected concentration of analyte of interest ( $AOI_{Theoretical}$ ) is calculated as follows:

$$AOI_{Theoretical} = \left( \frac{Tracer_{sample}}{Tracer_{cylinder}} \right) (AOI_{cylinder}) + \left[ 1 - \left( \frac{Tracer_{sample}}{Tracer_{cylinder}} \right) \right] (AOI_{native})$$

Where:

AOI<sub>Theoretical</sub> = Theoretical analyte of interest concentration (parts per million (ppm)).

Tracer<sub>sample</sub> = Tracer concentration (ppm) as seen by the Fourier Transform Infrared Spectrometer during spiking.

Tracer<sub>cylinder</sub> = The concentration (ppm) of tracer recorded during direct injection of the cylinder to the Fourier Transform Infrared Spectrometer cell.

AOI<sub>cylinder</sub> = The supplier-certified concentration (ppm) of the analyte of interest gas standard.

AOI<sub>native</sub> = The native AOI concentration (ppm) of the effluent during stable conditions.

- (14) **Post-test calibration.** At the end of a sampling run and at the end of the field study, record the spectrum of the calibration transfer standard gas. The resulting “final field calibration transfer standard spectrum” must be compared to the initial field calibration transfer standard spectrum to verify suitable stability of the spectroscopic system throughout the course of the field study.
  - (15) **Amendment of analytical routines.** The presence of unanticipated interferant compounds and/or the observation of compounds at concentrations outside their expected concentration ranges may necessitate the repetition of portions of the procedures in paragraphs (b)(2) through (14) of this appendix. Such amendments are allowable before final analysis of the data, but must be represented in the documentation required in paragraph (b)(16) of this appendix.
  - (16) **Documentation.** The sampling and spiking techniques used to generate the field study spectra and to convert sample spectral information to concentrations must be documented at a level of detail that allows an independent analyst to reproduce the results from the documentation and the stored interferometric data.
  - (17) **Method application.** When the required laboratory and field studies have been completed and if the results indicate a suitable degree of accuracy, the methods developed may be applied to practical field measurement tasks. During field applications, the procedures demonstrated in the field study specified in paragraphs (b)(8) through (16) of this appendix must be adhered to as closely as possible, with the following exceptions specified in paragraphs (b)(17)(i) through (iii) of this appendix:
    - (i) The sampling lines employed should be as short as practically possible and not longer than those used in the field study.
    - (ii) Analyte spiking and reactivity checks are required after the installation of or major repair to the sampling system or major change in sample matrix. In these cases, perform three spiked/ unspiked samples with calibration transfer standard or a surrogate analyte on a daily basis if time permits and gas standards are easy to obtain and get on-site.
    - (iii) Sampling and other operational data must be recorded and documented as during the field study, but only the interferometric data needed to sufficiently reproduce actual test and spiking data must be stored permanently. The format of this data does not need to be interferograms but may be absorbance spectra or single beams.
- (c) When using the flow and dilution measurement protocol specified in section 2.2.6 of EPA 430-R-10-003 (incorporated by reference, see § 98.7), you may determine point-of-use abatement device total volume flow with the modifications specified in paragraphs (c)(1) through (3) of this appendix.

- (1) You may introduce the non-reactive, non-native gas used for determining total volume flow and dilution across the point-of-use abatement device at a location in the exhaust of the point-of-use abatement device. For abatement systems operating in a mode where specific F-GHG are not readily abated, you may introduce the non-reactive, non-native gas used for determining total volume flow and dilution across the point-of-use abatement device prior to the point-of-use abatement system; in this case, the tracer must be more difficult to destroy than the target compounds being measured based on the thermal stability of the tracer and target.
- (2) You may select a location for downstream non-reactive, non-native gas analysis that complies with the requirements in this paragraph (c)(2) of this appendix. The sampling location should be traversed with the sampling probe measuring the non-reactive, non-native gas concentrations to ensure homogeneity of the non-reactive gas and point-of-use abatement device effluent (i.e., stratification test). To test for stratification, measure the non-reactive, non-native gas concentrations at three points on a line passing through the centroidal area. Space the three points at 16.7, 50.0, and 83.3 percent of the measurement line. Sample for a minimum of twice the system response time, determined according to paragraph (c)(3) of this appendix, at each traverse point. Calculate the individual point and mean non-reactive, non-native gas concentrations. If the non-reactive, non-native gas concentration at each traverse point differs from the mean concentration for all traverse points by no more than  $\pm 5.0$  percent of the mean concentration, the gas stream is considered unstratified and you may collect samples from a single point that most closely matches the mean. If the 5.0 percent criterion is not met, but the concentration at each traverse point differs from the mean concentration for all traverse points by no more than  $\pm 10.0$  percent of the mean, you may take samples from two points and use the average of the two measurements. Space the two points at 16.7, 50.0, or 83.3 percent of the measurement line. If the concentration at each traverse point differs from the mean concentration for all traverse points by more than  $\pm 10.0$  percent of the mean but less than 20.0 percent, take samples from three points at 16.7, 50.0, and 83.3 percent of the measurement line and use the average of the three measurements. If the gas stream is found to be stratified because the 20.0 percent criterion for a 3-point test is not met, locate and sample the non-reactive, non-native gas from traverse points for the test in accordance with Sections 11.2 and 11.3 of EPA Method 1 in 40 CFR part 60, Appendix A-1. A minimum of 40 non-reactive gas concentration measurements will be collected at three to five different injected non-reactive gas flow rates for determination of point-of-use abatement device effluent flow. The total volume flow of the point-of-use abatement device exhaust will be calculated consistent with the EPA 430-R-10-003 (incorporated by reference, see § 98.7) Equations 1 through 7.
- (3) You must determine the measurement system response time according to paragraphs (c)(3)(i) through (iii) of this appendix.
  - (i) Before sampling begins, introduce ambient air at the probe upstream of all sample condition components in system calibration mode. Record the time it takes for the measured concentration of a selected compound (for example, carbon dioxide) to reach steady state.
  - (ii) Introduce nitrogen in the system calibration mode and record the time required for the concentration of the selected compound to reach steady state.
  - (iii) Observe the time required to achieve 95 percent of a stable response for both nitrogen and ambient air. The longer interval is the measurement system response time.

[78 FR 68234, Nov. 13, 2013]

## Subpart J [Reserved]

## Subpart K—Ferroalloy Production

### § 98.110 Definition of the source category.

The ferroalloy production source category consists of any facility that uses pyrometallurgical techniques to produce any of the following metals: ferrochromium, ferromanganese, ferromolybdenum, ferronickel, ferrosilicon, ferrotitanium, ferrotungsten, ferrovandium, silicomanganese, or silicon metal.

### § 98.111 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a ferroalloy production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.112 GHGs to report.

You must report:

- (a) Process CO<sub>2</sub> emissions from each electric arc furnace (EAF) used for the production of any ferroalloy listed in § 98.110, and process CH<sub>4</sub> emissions from each EAF that is used for the production of any ferroalloy listed in Table K-1 to subpart K.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit following the requirements of subpart C of this part. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66461, Oct. 28, 2010]

### § 98.113 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each EAF not subject to paragraph (c) of this section using the procedures in either paragraph (a) or (b) of this section. For each EAF also subject to annual process CH<sub>4</sub> emissions reporting, you must also calculate and report the annual process CH<sub>4</sub> emissions from the EAF using the procedures in paragraph (d) of this section.

- (a) Calculate and report under this subpart the process CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart the annual process CO<sub>2</sub> emissions using the procedure in either paragraph (b)(1) or (b)(2) of this section.
  - (1) Calculate and report under this subpart the annual process CO<sub>2</sub> emissions from EAFs by operating and maintaining a CEMS according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and the applicable requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
  - (2) Calculate and report under this subpart the annual process CO<sub>2</sub> emissions from the EAFs using the carbon mass balance procedure specified in paragraphs (b)(2)(i) and (b)(2)(ii) of this section.

- (i) For each EAF, determine the annual mass of carbon in each carbon-containing input and output material for the EAF and estimate annual process CO<sub>2</sub> emissions from the EAF using Equation K-1 of this section. Carbon-containing input materials include carbon electrodes and carbonaceous reducing agents. If you document that a specific input or output material contributes less than 1 percent of the total carbon into or out of the process, you do not have to include the material in your calculation using Equation K-1 of this section.

$$\begin{aligned}
 E_{\text{CO}_2} = & \frac{44}{12} \times \frac{2000}{2205} \times \sum_i \left( M_{\text{reducing agent}_i} \times C_{\text{reducing agent}_i} \right) \\
 & + \frac{44}{12} \times \frac{2000}{2205} \times \sum_m \left( M_{\text{electrode}_m} \times C_{\text{electrode}_m} \right) \\
 & + \frac{44}{12} \times \frac{2000}{2205} \times \sum_h \left( M_{\text{ore}_h} \times C_{\text{ore}_h} \right) \\
 & + \frac{44}{12} \times \frac{2000}{2205} \times \sum_i \left( M_{\text{input}_i} \times C_{\text{input}_i} \right) \\
 & - \frac{44}{12} \times \frac{2000}{2205} \times \sum_j \left( M_{\text{product output}_j} \times C_{\text{product output}_j} \right) \\
 & - \frac{44}{12} \times \frac{2000}{2205} \times \sum_k \left( M_{\text{non-product output}_k} \times C_{\text{non-product output}_k} \right)
 \end{aligned}
 \tag{Eq. K-1}$$

Where:

$E_{\text{CO}_2}$  = Annual process CO<sub>2</sub> emissions from an individual EAF (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

2000/2205 = Conversion factor to convert tons to metric tons.

$M_{\text{reducing agent}_i}$  = Annual mass of reducing agent  $i$  fed, charged, or otherwise introduced into the EAF (tons).

$C_{\text{reducing agent}_i}$  = Carbon content in reducing agent  $i$  (percent by weight, expressed as a decimal fraction).

$M_{\text{electrode}_m}$  = Annual mass of carbon electrode  $m$  consumed in the EAF (tons).

$C_{\text{electrode}_m}$  = Carbon content of the carbon electrode  $m$  (percent by weight, expressed as a decimal fraction).

$M_{\text{ore}_h}$  = Annual mass of ore  $h$  charged to the EAF (tons).

$C_{ore_h}$  = Carbon content in ore  $h$  (percent by weight, expressed as a decimal fraction).

$M_{flux_j}$  = Annual mass of flux material  $j$  fed, charged, or otherwise introduced into the EAF to facilitate slag formation (tons).

$C_{flux_j}$  = Carbon content in flux material  $j$  (percent by weight, expressed as a decimal fraction).

$M_{product_k}$  = Annual mass of alloy product  $k$  tapped from EAF (tons).

$C_{product_k}$  = Carbon content in alloy product  $k$ . (percent by weight, expressed as a decimal fraction).

$M_{non-product\ outgoing_l}$  = Annual mass of non-product outgoing material  $l$  removed from EAF (tons).

$C_{non-product\ outgoing_l}$  = Carbon content in non-product outgoing material  $l$  (percent by weight, expressed as a decimal fraction).

- (ii) Determine the combined annual process CO<sub>2</sub> emissions from the EAFs at your facility using Equation K-2 of this section.

$$CO_2 = \sum_1^k E_{CO_2_k} \quad (\text{Eq. K-2})$$

Where:

$CO_2$  = Annual process CO<sub>2</sub> emissions from EAFs at facility used for the production of any ferroalloy listed in § 98.110 (metric tons).

$E_{CO_2_k}$  = Annual process CO<sub>2</sub> emissions calculated from EAF  $k$  calculated using Equation K-1 of this section (metric tons).

$k$  = Total number of EAFs at facility used for the production of any ferroalloy listed in § 98.110.

- (c) If GHG emissions from an EAF are vented through the same stack as any combustion unit or process equipment that reports CO<sub>2</sub> emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate process emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.
- (d) For the EAFs at your facility used for the production of any ferroalloy listed in Table K-1 of this subpart, you must calculate and report the annual CH<sub>4</sub> emissions using the procedure specified in paragraphs (d)(1) and (2) of this section.
- (1) For each EAF, determine the annual CH<sub>4</sub> emissions using Equation K-3 of this section.



$$E_{CH_4} = \sum_i (M_{product_i} \times \frac{2}{2205} \times EF_{product_i}) \quad (\text{Eq. K-3})$$

Where:

$E_{CH_4}$  = Annual process  $CH_4$  emissions from an individual EAF (metric tons).

$M_{product_i}$  = Annual mass of alloy product  $i$  produced in the EAF (tons).

$2/2205$  = Conversion factor to convert kg  $CH_4$ /ton of product to metric tons  $CH_4$ .

$EF_{product_i}$  =  $CH_4$  emission factor for alloy product  $i$  from Table K-1 in this subpart (kg of  $CH_4$  emissions per metric ton of alloy product  $i$ ).

- (2) Determine the combined process  $CH_4$  emissions from the EAFs at your facility using Equation K-4 of this section:

$$CH_4 = \sum_j E_{CH_4_j} \quad (\text{Eq. K-4})$$

Where:

$CH_4$  = Annual process  $CH_4$  emissions from EAFs at facility used for the production of ferroalloys listed in Table K-1 of this subpart (metric tons).

$E_{CH_4_j}$  = Annual process  $CH_4$  emissions from EAF  $j$  calculated using Equation K-3 of this section (metric tons).

$j$  = Total number of EAFs at facility used for the production of ferroalloys listed in Table K-1 of this subpart.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66461, Oct. 28, 2010; 78 FR 71954, Nov. 29, 2013]

## § 98.114 Monitoring and QA/QC requirements.

If you determine annual process  $CO_2$  emissions using the carbon mass balance procedure in § 98.113(b)(2), you must meet the requirements specified in paragraphs (a) and (b) of this section.

- (a) Determine the annual mass for each material used for the calculations of annual process  $CO_2$  emissions using Equation K-1 of this subpart by summing the monthly mass for the material determined for each month of the calendar year. The monthly mass may be determined using plant instruments used for accounting purposes, including either direct measurement of the quantity of the material placed in the unit or by calculations using process operating information.
- (b) For each material identified in paragraph (a) of this section, you must determine the average carbon content of the material consumed, used, or produced in the calendar year using the methods specified in either paragraph (b)(1) or (b)(2) of this section. If you document that a specific process input or output contributes less than one percent of the total mass of carbon into or out of the process, you do not have to determine the monthly mass or annual carbon content of that input or output.

- (1) Information provided by your material supplier.
- (2) Collecting and analyzing at least three representative samples of the material inputs and outputs each year. The carbon content of the material must be analyzed at least annually using the standard methods (and their QA/QC procedures) specified in paragraphs (b)(2)(i) through (b)(2)(iii) of this section, as applicable.
  - (i) ASTM E1941-04, Standard Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys (incorporated by reference, see § 98.7) for analysis of metal ore and alloy product.
  - (ii) ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7), for analysis of carbonaceous reducing agents and carbon electrodes.
  - (iii) ASTM C25-06, Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime (incorporated by reference, see § 98.7) for analysis of flux materials such as limestone or dolomite.

### § 98.115 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations in § 98.113 is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in the paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) If you determine CO<sub>2</sub> emissions for the EAFs at your facility using the carbon mass balance procedure in § 98.113(b), 100 percent data availability is required for the carbon content of the input and output materials. You must repeat the test for average carbon contents of inputs according to the procedures in § 98.114(b) if data are missing.
- (b) For missing records of the monthly mass of carbon-containing inputs and outputs, the substitute data value must be based on the best available estimate of the mass of the inputs and outputs from on all available process data or data used for accounting purposes, such as purchase records.
- (c) If you are required to calculate CH<sub>4</sub> emissions for an EAF at your facility as specified in § 98.113(d), the estimate is based on an annual quantity of certain alloy products, so 100 percent data availability is required.

### § 98.116 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (e) of this section, as applicable:

- (a) Annual facility ferroalloy product production capacity (tons).
- (b) If a CEMS is used to measure CO<sub>2</sub> emissions, report the annual production for each ferroalloy product identified in § 98.110, from each EAF (tons).
- (c) Total number of EAFs at facility used for production of ferroalloy products.
- (d) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required by § 98.36 for the Tier 4 Calculation Methodology and the following information specified in paragraphs (d)(1) through (d)(3) of this section.

- (1) Annual process CO<sub>2</sub> emissions (in metric tons) from each EAF used for the production of any ferroalloy product identified in § 98.110.
- (2) Annual process CH<sub>4</sub> emissions (in metric tons) from each EAF used for the production of any ferroalloy listed in Table K-1 of this subpart (metric tons).
- (3) Identification number of each EAF.
- (e) If a CEMS is not used to measure CO<sub>2</sub> process emissions, and the carbon mass balance procedure is used to determine CO<sub>2</sub> emissions according to the requirements in § 98.113(b), then you must report the following information specified in paragraphs (e)(1) through (e)(7) of this section.
  - (1) Annual process CO<sub>2</sub> emissions (in metric tons) from each EAF used for the production of any ferroalloy identified in § 98.110 (metric tons).
  - (2) Annual process CH<sub>4</sub> emissions (in metric tons) from each EAF used for the production of any ferroalloy listed in Table K-1 of this subpart.
  - (3) Identification number for each material.
  - (4)-(5) [Reserved]
  - (6) List the method used for the determination of carbon content for each material included for the calculation of annual process CO<sub>2</sub> emissions for each EAF (e.g., supplier provided information, analyses of representative samples you collected).
  - (7) If you use the missing data procedures in § 98.115(b), you must report how monthly mass of carbon-containing inputs and outputs with missing data was determined and the number of months the missing data procedures were used.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66462, Oct. 28, 2010; 78 FR 71954, Nov. 29, 2013; 79 FR 63785, Oct. 24, 2014]

### § 98.117 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (e) of this section for each EAF, as applicable.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions according to the requirements in § 98.113(a), then you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37 and the information specified in paragraphs (a)(1) through (a)(3) of this section.
  - (1) Monthly EAF production quantity for each ferroalloy product (tons).
  - (2) Number of EAF operating hours each month.
  - (3) Number of EAF operating hours in a calendar year.
- (b) If the carbon mass balance procedure is used to determine CO<sub>2</sub> emissions according to the requirements in § 98.113(b)(2), then you must retain records for the information specified in paragraphs (b)(1) through (b)(5) of this section.
  - (1) Monthly EAF production quantity for each ferroalloy product (tons).
  - (2) Number of EAF operating hours each month.
  - (3) Number of EAF operating hours in a calendar year.

- (4) Monthly material quantity consumed, used, or produced for each material included for the calculations of annual process CO<sub>2</sub> emissions (tons).
- (5) Average carbon content determined and records of the supplier provided information or analyses used for the determination for each material included for the calculations of annual process CO<sub>2</sub> emissions.
- (c) You must keep records that include a detailed explanation of how company records of measurements are used to estimate the carbon input and output to each EAF, including documentation of specific input or output materials excluded from Equation K-1 of this subpart that contribute less than 1 percent of the total carbon into or out of the process. You also must document the procedures used to ensure the accuracy of the measurements of materials fed, charged, or placed in an EAF including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (d) If you are required to calculate CH<sub>4</sub> emissions for the EAF as specified in § 98.113(d), you must maintain records of the total amount of each alloy product produced for the specified reporting period, and the appropriate alloy-product specific emission factor used to calculate the CH<sub>4</sub> emissions.
- (e) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (e)(1) through (13) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (e)(1) through (13) of this section.
  - (1) Carbon content in reducing agent (percent by weight, expressed as a decimal fraction) (Equation K-1 of § 98.113).
  - (2) Annual mass of reducing agent fed, charged, or otherwise introduced into the EAF (tons) (Equation K-1).
  - (3) Carbon content of carbon electrode (percent by weight, expressed as a decimal fraction) (Equation K-1).
  - (4) Annual mass of carbon electrode consumed in the EAF (tons) (Equation K-1).
  - (5) Carbon content in ore (percent by weight, expressed as a decimal fraction) (Equation K-1).
  - (6) Annual mass of ore charged to the EAF (tons) (Equation K-1).
  - (7) Carbon content in flux material (percent by weight, expressed as a decimal fraction) (Equation K-1).
  - (8) Annual mass of flux material fed, charged, or otherwise introduced into the EAF to facilitate slag formation (tons) (Equation K-1).
  - (9) Carbon content in alloy product (percent by weight, expressed as a decimal fraction) (Equation K-1).
  - (10) Annual mass of alloy product produced/tapped in the EAF (tons) (Equation K-1).
  - (11) Carbon content in non-product outgoing material (percent by weight, expressed as a decimal fraction) (Equation K-1).
  - (12) Annual mass of non-product outgoing material removed from EAF (tons) (Equation K-1).
  - (13) CH<sub>4</sub> emission factor selected from Table K-1 of this subpart for each product (kg of CH<sub>4</sub> emissions/metric ton of alloy product) (Equation K-3 of § 98.113).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63785, Oct. 24, 2014]

§ 98.118 Definitions.

All terms used of this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

Table K-1 to Subpart K of Part 98—Electric Arc Furnace (EAF) CH<sub>4</sub> Emission Factors

| Alloy product produced in EAF | CH <sub>4</sub> emission factor<br>(kg CH <sub>4</sub> per metric ton product) |                                |                                               |
|-------------------------------|--------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------|
|                               | EAF Operation                                                                  |                                |                                               |
|                               | Batch-charging                                                                 | Sprinkle-charging <sup>a</sup> | Sprinkle-charging and<br>>750 °C <sup>b</sup> |
| Silicon metal                 | 1.5                                                                            | 1.2                            | 0.7                                           |
| Ferrosilicon 90%              | 1.4                                                                            | 1.1                            | 0.6                                           |
| Ferrosilicon 75%              | 1.3                                                                            | 1.0                            | 0.5                                           |
| Ferrosilicon 65%              | 1.3                                                                            | 1.0                            | 0.5                                           |

<sup>a</sup> Sprinkle-charging is charging intermittently every minute.  
<sup>b</sup> Temperature measured in off-gas channel downstream of the furnace hood.

Subpart L—Fluorinated Gas Production

Source: 75 FR 74831, Dec. 1, 2010, unless otherwise noted.

§ 98.120 Definition of the source category.

- (a) The fluorinated gas production source category consists of processes that produce a fluorinated gas from any raw material or feedstock chemical, except for processes that generate HFC-23 during the production of HCFC-22.
- (b) To produce a fluorinated gas means to manufacture a fluorinated gas from any raw material or feedstock chemical. Producing a fluorinated gas includes producing a fluorinated GHG as defined at § 98.410(b). Producing a fluorinated gas also includes the manufacture of a chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) from any raw material or feedstock chemical, including manufacture of a CFC or HCFC as an isolated intermediate for use in a process that will result in the transformation of the CFC or HCFC either at or outside of the production facility. Producing a fluorinated gas does not include the reuse or recycling of a fluorinated gas, the creation of HFC-23 during the production of HCFC-22, the creation of intermediates that are created and transformed in a single process with no storage of the intermediates, or the creation of fluorinated GHGs that are released or destroyed at the production facility before the production measurement in § 98.414(a).

## § 98.121 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a fluorinated gas production process that generates or emits fluorinated GHG and the facility meets the requirements of either § 98.2(a)(1) or (a)(2). To calculate GHG emissions for comparison to the 25,000 metric ton CO<sub>2</sub>e per year emission threshold in § 98.2(a)(2), calculate process emissions from fluorinated gas production using uncontrolled GHG emissions.

## § 98.122 GHGs to report.

- (a) You must report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions from each stationary combustion unit. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (b) You must report under subpart O of this part (HCFC-22 Production and HFC-23 Destruction) the emissions of HFC-23 from HCFC-22 production processes and HFC-23 destruction processes. Do not report the generation and emissions of HFC-23 from HCFC-22 production under this subpart.
- (c) **Emissions from production and transformation processes, process level.** You must report, for each fluorinated GHG group, the total GWP-weighted mass of all fluorinated GHGs in that group (in metric tons CO<sub>2</sub>e) emitted from:
  - (1) Each fluorinated gas production process.
  - (2) Each fluorinated gas transformation process that is not part of a fluorinated gas production process and where no fluorinated GHG reactant is produced at another facility.
  - (3) Each fluorinated gas transformation process that is not part of a fluorinated gas production process and where one or more fluorinated GHG reactants are produced at another facility.
- (d) **Emissions from production and transformation processes, facility level, multiple products.** If your facility produces more than one fluorinated gas product, you must report the emissions (in metric tons) from production and transformation processes, totaled across the facility as a whole, of each fluorinated GHG that is emitted in quantities of 1,000 metric tons of CO<sub>2</sub>e or more from production or transformation processes, totaled across the facility as a whole. Aggregate and report emissions of all other fluorinated GHGs from production and transformation processes by fluorinated GHG group for the facility as a whole, in metric tons of CO<sub>2</sub>e.
- (e) **Emissions from production and transformation processes, facility level, one product only.** If your facility produces only one fluorinated gas product, aggregate and report the GWP-weighted emissions from production and transformation processes of fluorinated GHGs by fluorinated GHG group for the facility as a whole, in metric tons CO<sub>2</sub>e, with the following exception: Where emissions consist of a major fluorinated GHG constituent of a fluorinated gas product, and the product is sold or transferred to another person, report the total mass of each fluorinated GHG that is emitted from production and transformation processes and that is a major fluorinated GHG constituent of the product (in metric tons).
- (f) **Emissions from destruction processes and venting of containers.** You must report the total mass of each fluorinated GHG emitted (in metric tons) from:
  - (1) Each fluorinated gas destruction process that is not part of a fluorinated gas production process or a fluorinated gas transformation process and all such fluorinated gas destruction processes combined.
  - (2) Venting of residual fluorinated GHGs from containers returned from the field.

[75 FR 74831, Dec. 1, 2010, as amended at 79 FR 73785, Dec. 11, 2014]

## § 98.123 Calculating GHG emissions.

For fluorinated gas production and transformation processes, you must calculate the fluorinated GHG emissions from each process using the emission factor or emission calculation factor method specified in paragraphs (c), (d), and (e) of this section, as appropriate. For destruction processes that destroy fluorinated GHGs that were previously “produced” as defined at § 98.410(b), you must calculate emissions using the procedures in paragraph (f) of this section. For venting of residual gas from containers (e.g., cylinder heels), you must calculate emissions using the procedures in paragraph (g) of this section.

(a) [Reserved]

(b) **Mass balance method.** The mass balance method was available for reporting years 2011, 2012, 2013, and 2014 only. See paragraph 1 of appendix A of this subpart for the former mass balance method.

(c) **Emission factor and emission calculation factor methods.** To use the method in this paragraph for batch processes, you must comply with either paragraph (c)(3) of this section (Emission Factor approach) or paragraph (c)(4) of this section (Emission Calculation Factor approach). To use the method in this paragraph for continuous processes, you must first make a preliminary estimate of the emissions from each individual continuous process vent under paragraph (c)(1) of this section. If your continuous process operates under different conditions as part of normal operations, you must also define the different operating scenarios and make a preliminary estimate of the emissions from the vent for each operating scenario. Then, compare the preliminary estimate for each continuous process vent (summed across operating scenarios) to the criteria in paragraph (c)(2) of this section to determine whether the process vent meets the criteria for using the emission factor method described in paragraph (c)(3) of this section or whether the process vent meets the criteria for using the emission calculation factor method described in paragraph (c)(4) of this section. For continuous process vents that meet the criteria for using the emission factor method described in paragraph (c)(3) of this section and that have more than one operating scenario, compare the preliminary estimate for each operating scenario to the criteria in (c)(3)(ii) to determine whether an emission factor must be developed for that operating scenario.

(1) **Preliminary estimate of emissions by process vent.** You must estimate the annual CO<sub>2</sub>e emissions of fluorinated GHGs for each process vent within each operating scenario of a continuous process using the approaches specified in paragraph (c)(1)(i) or (c)(1)(ii) of this section, accounting for any destruction as specified in paragraph (c)(1)(iii) of this section. You must determine emissions of fluorinated GHGs by process vent by using measurements, by using calculations based on chemical engineering principles and chemical property data, or by conducting an engineering assessment. You may use previous measurements, calculations, and assessments if they represent current process operating conditions or process operating conditions that would result in higher fluorinated GHG emissions than the current operating conditions and if they were performed in accordance with paragraphs (c)(1)(i), (c)(1)(ii), and (c)(1)(iii) of this section, as applicable. You must document all data, assumptions, and procedures used in the calculations or engineering assessment and keep a record of the emissions determination as required by § 98.127(a).

(i) **Engineering calculations.** For process vent emission calculations, you may use any of paragraphs (c)(1)(i)(A), (c)(1)(i)(B), or (c)(1)(i)(C) of this section.

- (A) U.S. Environmental Protection Agency, Emission Inventory Improvement Program, Volume II: Chapter 16, Methods for Estimating Air Emissions from Chemical Manufacturing Facilities, August 2007, Final (incorporated by reference, see § 98.7).
- (B) You may determine the fluorinated GHG emissions from any process vent within the process using the procedures specified in § 63.1257(d)(2)(i) and (d)(3)(i)(B) of this chapter, except as specified in paragraphs (c)(1)(i)(B)(1) through (c)(1)(i)(B)(4) of this section. For the purposes of this subpart, use of the term “HAP” in § 63.1257(d)(2)(i) and (d)(3)(i)(B) of this chapter means “fluorinated GHG”.
  - (1) To calculate emissions caused by the heating of a vessel without a process condenser to a temperature lower than the boiling point, you must use the procedures in § 63.1257(d)(2)(i)(C)(3) of this chapter.
  - (2) To calculate emissions from depressurization of a vessel without a process condenser, you must use the procedures in § 63.1257(d)(2)(i)(D)(10) of this chapter.
  - (3) To calculate emissions from vacuum systems, the terms used in Equation 33 to § 63.1257(d)(2)(i)(E) of this chapter are defined as follows:
    - (i)  $P_{\text{system}}$  = Absolute pressure of the receiving vessel.
    - (ii)  $P_i$  = Partial pressure of the fluorinated GHG determined at the exit temperature and exit pressure conditions of the condenser or at the conditions of the dedicated receiver.
    - (iii)  $P_j$  = Partial pressure of condensables (including fluorinated GHG) determined at the exit temperature and exit pressure conditions of the condenser or at the conditions of the dedicated receiver.
    - (iv)  $MW_{\text{Fluorinated GHG}}$  = Molecular weight of the fluorinated GHG determined at the exit temperature and exit pressure conditions of the condenser or at the conditions of the dedicated receiver.
  - (4) To calculate emissions when a vessel is equipped with a process condenser or a control condenser, you must use the procedures in § 63.1257(d)(3)(i)(B) of this chapter, except as follows:
    - (i) You must determine the flowrate of gas (or volume of gas), partial pressures of condensables, temperature (T), and fluorinated GHG molecular weight ( $MW_{\text{Fluorinated GHG}}$ ) at the exit temperature and exit pressure conditions of the condenser or at the conditions of the dedicated receiver.
    - (ii) You must assume that all of the components contained in the condenser exit vent stream are in equilibrium with the same components in the exit condensate stream (except for noncondensables).
    - (iii) You must perform a material balance for each component, if the condensate receiver composition is not known.
    - (iv) For the emissions from gas evolution, the term for time, t, must be used in Equation 12 to § 63.1257(d)(2)(i)(B) of this chapter.



- (v) Emissions from empty vessel purging must be calculated using Equation 36 to § 63.1257(d)(2)(i)(H) of this chapter and the exit temperature and exit pressure conditions of the condenser or the conditions of the dedicated receiver.
    - (C) Commercial software products that follow chemical engineering principles (e.g., including the calculation methodologies in paragraphs (c)(1)(i)(A) and (c)(1)(i)(B) of this section).
  - (ii) **Engineering assessments.** For process vent emissions determinations, you may conduct an engineering assessment to calculate uncontrolled emissions. An engineering assessment includes, but is not limited to, the following:
    - (A) Previous test results, provided the tests are representative of current operating practices of the process.
    - (B) Bench-scale or pilot-scale test data representative of the process operating conditions.
    - (C) Maximum flow rate, fluorinated GHG emission rate, concentration, or other relevant parameters specified or implied within a permit limit applicable to the process vent.
    - (D) Design analysis based on chemical engineering principles, measureable process parameters, or physical or chemical laws or properties.
  - (iii) **Impact of destruction for the preliminary estimate.** If the process vent is vented to a destruction device, you may reflect the impact of the destruction device on emissions. In your emissions estimate, account for the following:
    - (A) The destruction efficiencies of the device that have been demonstrated for the fluorinated GHGs in the vent stream for periods when the process vent is vented to the destruction device.
    - (B) Any periods when the process vent is not vented to the destruction device.
  - (iv) **Use of typical recent values.** In the calculations in paragraphs (c)(1)(i), (c)(1)(ii), and (c)(1)(iii) of this section, the values used for the expected process activity and for the expected fraction of that activity whose emissions will be vented to the properly functioning destruction device must be based on either typical recent values for the process or values that would overestimate emissions from the process, unless there is a compelling reason to adopt a different value (e.g., installation of a destruction device for a previously uncontrolled process). If there is such a reason, it must be documented in the GHG Monitoring Plan.
  - (v) **GWPs.** To convert the fluorinated GHG emissions to CO<sub>2</sub>e, use Equation A-1 of § 98.2.
  - (vi) [Reserved]
- (2) **Method selection for continuous process vents.**
- (i) If the calculations under paragraph (c)(1) of this section, as well as any subsequent measurements and calculations under this subpart, indicate that the continuous process vent has fluorinated GHG emissions of less than 10,000 metric ton CO<sub>2</sub>e per year, summed across all operating scenarios, then you may comply with either paragraph (c)(3) of this section (Emission Factor approach) or paragraph (c)(4) of this section (Emission Calculation Factor approach).

- (ii) If the continuous process vent does not meet the criteria in paragraph (c)(2)(i) of this section, then you must comply with the emission factor method specified in paragraph (c)(3) (Emission Factor approach) of this section.
  - (A) You must conduct emission testing for process-vent-specific emission factor development before the destruction device unless the calculations you performed under paragraph (c)(1)(iii) of this section indicate that the uncontrolled fluorinated GHG emissions that occur during periods when the process vent is not vented to the properly functioning destruction device are less than 10,000 metric tons CO<sub>2</sub>e per year. In this case, you may conduct emission testing after the destruction device to develop a process-vent-specific emission factor. If you do so, you must develop and apply an emission calculation factor under paragraph (c)(4) to estimate emissions during any periods when the process vent is not vented to the properly functioning destruction device.
  - (B) Regardless of the level of uncontrolled emissions, the emission testing for process-vent-specific emission factor development may be conducted on the outlet side of a wet scrubber in place for acid gas reduction, if one is in place, as long as there is no appreciable reduction in the fluorinated GHG.

(3) ***Process-vent-specific emission factor method.*** For each process vent, conduct an emission test and measure fluorinated GHG emissions from the process and measure the process activity, such as the feed rate, production rate, or other process activity rate, during the test as described in this paragraph (c)(3). Conduct the emission test according to the procedures in § 98.124. All emissions test data and procedures used in developing emission factors must be documented according to § 98.127. If more than one operating scenario applies to the process that contains the subject process vent, you must comply with either paragraph (3)(i) or paragraph (3)(ii) of this section.

- (i) Conduct a separate emissions test for operation under each operating scenario.
- (ii) Conduct an emissions test for the operating scenario that is expected to have the largest emissions in terms of CO<sub>2</sub>e (considering both activity levels and emission calculation factors) on an annual basis. Also conduct an emissions test for each additional operating scenario that is estimated to emit 10,000 metric tons CO<sub>2</sub>e or more annually from the vent and whose emission calculation factor differs by 15 percent or more from the emission calculation factor of the operating scenario that is expected to have the largest emissions (or of another operating scenario for which emission testing is performed), unless the difference between the operating scenarios is solely due to the application of a destruction device to emissions under one of the operating scenarios. For any other operating scenarios, adjust the process-vent specific emission factor developed for the operating scenario that is expected to have the largest emissions (or for another operating scenario for which emission testing is performed) using the approach in paragraph (c)(3)(viii) of this section.
- (iii) You must measure the process activity, such as the process feed rate, process production rate, or other process activity rate, as applicable, during the emission test and calculate the rate for the test period, in kg (or another appropriate metric) per hour.
- (iv) For continuous processes, you must calculate the hourly emission rate of each fluorinated GHG using Equation L-19 of this section and determine the hourly emission rate of each fluorinated GHG per process vent (and per operating scenario, as applicable) for the test run.

$$E_{ContPV} = \frac{C_{PV}}{10^6} * MW * Q_{PV} * \frac{1}{SV} * \frac{1}{10^3} * \frac{60}{1} \quad (\text{Eq. L-19})$$

Where:

$E_{ContPV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, during the emission test during test run r (kg/hr).

$C_{PV}$  = Concentration of fluorinated GHG f during test run r of the emission test (ppmv).

MW = Molecular weight of fluorinated GHG f (g/g-mole).

$Q_{PV}$  = Flow rate of the process vent stream during test run r of the emission test (m<sup>3</sup>/min).

SV = Standard molar volume of gas (0.0240 m<sup>3</sup>/g-mole at 68 °F and 1 atm).

1/10<sup>3</sup> = Conversion factor (1 kilogram/1,000 grams).

60/1 = Conversion factor (60 minutes/1 hour).

- (v) You must calculate a site-specific, process-vent-specific emission factor for each fluorinated GHG for each process vent and each operating scenario, in kg of fluorinated GHG per process activity rate (e.g., kg of feed or production), as applicable, using Equation L-20 of this section. For continuous processes, divide the hourly fluorinated GHG emission rate during the test by the hourly process activity rate during the test runs.

$$EF_{PV} = \frac{\sum_1^r \left( \frac{E_{PV}}{Activity_{EmissionTest}} \right)}{r} \quad (\text{Eq. L-20})$$

Where:

$EF_{PV}$  = Emission factor for fluorinated GHG f emitted from process vent v during process i, operating scenario j (e.g., kg emitted/kg activity).

$E_{PV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, during the emission test during test run r, for either continuous or batch (kg emitted/hr for continuous, kg emitted/batch for batch).

$Activity_{EmissionTest}$  = Process feed, process production, or other process activity rate for process i, operating scenario j, during the emission test during test run r (e.g., kg product/hr).

r = Number of test runs performed during the emission test.

- (vi) If you conducted emissions testing after the destruction device, you must calculate the emissions of each fluorinated GHG for the process vent (and operating scenario, as applicable) using Equation L-21 of this section. You must also develop a process-vent-specific emission calculation factor based on paragraph (c)(4) of this section for the periods when the process vent is not venting to the destruction device.

$$E_{PV} = EF_{PV-C} * Activity_C + ECF_{PV-U} * Activity_U \quad (\text{Eq. L-21})$$

Where:

$E_{PV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, for the year (kg).

$EF_{PV-C}$  = Emission factor for fluorinated GHG f emitted from process vent v during process i, operating scenario j, based on testing after the destruction device (kg emitted/activity) (e.g., kg emitted/kg product).

$Activity_C$  = Total process feed, process production, or other process activity for process i, operating scenario j, during the year for which emissions are vented to the properly functioning destruction device (i.e., controlled).

$ECF_{PV-U}$  = Emission calculation factor for fluorinated GHG f emitted from process vent v during process i, operating scenario j during periods when the process vent is not vented to the properly functioning destruction device (kg emitted/activity) (e.g., kg emitted/kg product).

$Activity_U$  = Total process feed, process production, or other process activity during the year for which the process vent is not vented to the properly functioning destruction device (e.g., kg product).

- (vii) If you conducted emissions testing before the destruction device, apply the destruction efficiencies of the device that have been demonstrated for the fluorinated GHGs in the vent stream to the fluorinated GHG emissions for the process vent (and operating scenario, as applicable), using Equation L-22 of this section. You may apply the destruction efficiency only to the portion of the process activity during which emissions are vented to the properly functioning destruction device (i.e., controlled).

$$E_{PV} = EF_{PV-U} * (Activity_U + Activity_C * (1 - DE)) \quad (\text{Eq. L-22})$$

where:

$E_{PV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, for the year, considering destruction efficiency (kg).

$EF_{PV-U}$  = Emission factor (uncontrolled) for fluorinated GHG f emitted from process vent v during process i, operating scenario j (kg emitted/kg product).

$Activity_U$  = Total process feed, process production, or other process activity for process i, operating scenario j, during the year for which the process vent is not vented to the properly functioning destruction device (e.g., kg product).

Activity<sub>C</sub> = Total process feed, process production, or other process activity for process i, operating scenario j, during the year for which the process vent is vented to the properly functioning destruction device (e.g., kg product).

DE = Demonstrated destruction efficiency of the destruction device (weight fraction).

- (viii) **Adjusted process-vent-specific emission factors for other operating scenarios.** For process vents from processes with multiple operating scenarios, use Equation L-23 of this section to develop an adjusted process-vent-specific emission factor for each operating scenario from which the vent is estimated to emit less than 10,000 metric tons CO<sub>2</sub>e annually or whose emission calculation factor differs by less than 15 percent from the emission calculation factor of the operating scenario that is expected to have the largest emissions (or of another operating scenario for which emission testing is performed).

$$EF_{PVadj} = \frac{ECF_{UT}}{ECF_T} * EF_{PV} \quad (\text{Eq. L-23})$$

where:

EF<sub>PVadj</sub> = Adjusted process-vent-specific emission factor for an untested operating scenario.

ECF<sub>UT</sub> = Emission calculation factor for the untested operating scenario developed under paragraph (c)(4) of this section.

ECF<sub>T</sub> = Emission calculation for the tested operating scenario developed under paragraph (c)(4) of this section.

EF<sub>PV</sub> = Process vent specific emission factor for the tested operating scenario.

- (ix) Sum the emissions of each fluorinated GHG from all process vents in each operating scenario and all operating scenarios in the process for the year to estimate the total process vent emissions of each fluorinated GHG from the process, using Equation L-24 of this section.

$$E_{Pfi} = \sum_1^o \sum_1^v E_{PV} \quad (\text{Eq. L-24})$$

where:

E<sub>Pfi</sub> = Mass of fluorinated GHG f emitted from process vents for process i for the year (kg).

E<sub>PV</sub> = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, for the year, considering destruction efficiency (kg).

v = Number of process vents in process i, operating scenario j.

o = Number of operating scenarios for process i.

- (4) **Process-vent-specific emission calculation factor method.** For each process vent within an operating scenario, determine fluorinated GHG emissions by calculations and determine the process activity rate, such as the feed rate, production rate, or other process activity rate, associated with the emission rate.
- (i) You must calculate uncontrolled emissions of fluorinated GHG by individual process vent,  $E_{PV}$ , by using measurements, by using calculations based on chemical engineering principles and chemical property data, or by conducting an engineering assessment. Use the procedures in paragraphs (c)(1)(i) or (ii) of this section, except paragraph (c)(1)(ii)(C) of this section. The procedures in paragraphs (c)(1)(i) and (ii) of this section may be applied either to batch process vents or to continuous process vents. The uncontrolled emissions must be based on a typical batch or production rate under a defined operating scenario. The process activity rate associated with the uncontrolled emissions must be determined. The methods, data, and assumptions used to estimate emissions for each operating scenario must be selected to yield a best estimate (expected value) of emissions rather than an over- or underestimate of emissions for that operating scenario. All data, assumptions, and procedures used in the calculations or engineering assessment must be documented according to § 98.127.
- (ii) You must calculate a site-specific, process-vent-specific emission calculation factor for each process vent, each operating scenario, and each fluorinated GHG, in kg of fluorinated GHG per activity rate (e.g., kg of feed or production) as applicable, using Equation L-25 of this section.

$$ECF_{PV} = \frac{E_{PV}}{Activity_{Representative}} \quad (\text{Eq. L-25})$$

where:

$ECF_{PV}$  = Emission calculation factor for fluorinated GHG f emitted from process vent v during process i, operating scenario j, (e.g., kg emitted/kg product).

$E_{PV}$  = Average mass of fluorinated GHG f emitted, based on calculations, from process vent v from process i, operating scenario j, during the period or batch for which emissions were calculated, for either continuous or batch (kg emitted/hr for continuous, kg emitted/batch for batch).

$Activity_{Representative}$  = Process feed, process production, or other process activity rate corresponding to average mass of emissions based on calculations (e.g., kg product/hr for continuous, kg product/batch for batch).

- (iii) You must calculate emissions of each fluorinated GHG for the process vent (and operating scenario, as applicable) for the year by multiplying the process-vent-specific emission calculation factor by the total process activity, as applicable, for the year, using Equation L-26 of this section.

$$E_{PV} = ECF_{PV} * Activity \quad (\text{Eq. L-26})$$

where:

$E_{PV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, for the year (kg).

$ECF_{PV}$  = Emission calculation factor for fluorinated GHG f emitted from process vent v during process i, operating scenario j, (kg emitted/activity) (e.g., kg emitted/kg product).

Activity = Process feed, process production, or other process activity for process i, operating scenario j, during the year.

- (iv) If the process vent is vented to a destruction device, apply the demonstrated destruction efficiency of the device to the fluorinated GHG emissions for the process vent (and operating scenario, as applicable), using Equation L-27 of this section. Apply the destruction efficiency only to the portion of the process activity that is vented to the properly functioning destruction device (i.e., controlled).

$$E_{PV} = ECF_{PV} * (Activity_U + Activity_C * (1 - DE)) \quad (\text{Eq. L-27})$$

where:

$E_{PV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, for the year considering destruction efficiency (kg).

$ECF_{PV}$  = Emission calculation factor for fluorinated GHG f emitted from process vent v during process i, operating scenario j, (e.g., kg emitted/kg product).

$Activity_U$  = Total process feed, process production, or other process activity for process i, operating scenario j, during the year for which the process vent is not vented to the properly functioning destruction device (e.g., kg product).

$Activity_C$  = Total process feed, process production, or other process activity for process i, operating scenario j, during the year for which the process vent is vented to the properly functioning destruction device (e.g., kg product).

DE = Demonstrated destruction efficiency of the destruction device (weight fraction).

- (v) Sum the emissions of each fluorinated GHG from all process vents in each operating scenario and all operating scenarios in the process for the year to estimate the total process vent emissions of each fluorinated GHG from the process, using Equation L-28 of this section.

$$E_{Pfi} = \sum_{1}^o \sum_{1}^v E_{PV} \quad (\text{Eq. L-28})$$

where:

$E_{Pfi}$  = Mass of fluorinated GHG f emitted from process vents for process i for the year (kg).

$E_{PV}$  = Mass of fluorinated GHG f emitted from process vent v from process i, operating scenario j, for the year, considering destruction efficiency (kg).

v = Number of process vents in process i, operating scenario j.

o = Number of operating scenarios in process i.

(d) **Calculate fluorinated GHG emissions for equipment leaks (EL).** If you comply with paragraph (c) of this section, you must calculate the fluorinated GHG emissions from pieces of equipment associated with processes covered under this subpart and in fluorinated GHG service. If you conduct monitoring of equipment in fluorinated GHG service, monitoring must be conducted for those in light liquid and in gas and vapor service. If you conduct monitoring of equipment in fluorinated GHG service, you may exclude from monitoring each piece of equipment that is difficult-to-monitor, that is unsafe-to-monitor, that is insulated, or that is in heavy liquid service; you may exclude from monitoring each pump with dual mechanical seals, agitator with dual mechanical seals, pump with no external shaft, agitator with no external shaft; you may exclude from monitoring each pressure relief device in gas and vapor service with upstream rupture disk, each sampling connection system with closed-loop or closed-purge systems, and any pieces of equipment where leaks are routed through a closed vent system to a destruction device. You must estimate emissions using another approach for those pieces of equipment excluded from monitoring. Equipment that is in fluorinated GHG service for less than 300 hr/yr; equipment that is in vacuum service; pressure relief devices that are in light liquid service; and instrumentation systems are exempted from these requirements.

(1) The emissions from equipment leaks must be calculated using any of the procedures in paragraphs (d)(1)(i), (d)(1)(ii), (d)(1)(iii), or (d)(1)(iv) of this section.

(i) **Use of Average Emission Factor Approach in EPA Protocol for Equipment Leak Emission Estimates.** The emissions from equipment leaks may be calculated using the default Average Emission Factor Approach in EPA-453/R-95-017 (incorporated by reference, see § 98.7).

(ii) **Use of Other Approaches in EPA Protocol for Equipment Leak Emission Estimates in conjunction with EPA Method 21 at 40 CFR part 60, appendix A-7.** The emissions from equipment leaks may be calculated using one of the following methods in EPA-453/R-95-017 (incorporated by reference, see § 98.7): The Screening Ranges Approach; the EPA Correlation Approach; or the Unit-Specific Correlation Approach. If you determine that EPA Method 21 at 40 CFR part 60, appendix A-7 is appropriate for monitoring a fluorinated GHG, and if you calibrate your instrument with a compound different from one or more of the fluorinated GHGs or surrogates to be measured, you must develop response factors for each fluorinated GHG or for each surrogate to be measured using EPA Method 21 at 40 CFR part 60, appendix A-7. For each fluorinated GHG or surrogate measured, the response factor must be less than 10. The response factor is the ratio of the known concentration of a fluorinated GHG or surrogate to the observed meter reading when measured using an instrument calibrated with the reference compound.

(iii) **Use of Other Approaches in EPA Protocol for Equipment Leak Emission Estimates in conjunction with site-specific leak monitoring methods.** The emissions from equipment leaks may be calculated using one of the following methods in EPA-453/R-95-017 (incorporated by reference, see § 98.7): The Screening Ranges Approach; the EPA Correlation Approach; or the Unit-Specific Correlation Approach. You may develop a site-specific leak monitoring method appropriate for monitoring fluorinated GHGs or surrogates to use along with these three approaches. The site-specific leak monitoring method must meet the requirements in § 98.124(f)(1).



(iv) **Use of site-specific leak monitoring methods.** The emissions from equipment leaks may be calculated using a site-specific leak monitoring method. The site-specific leak monitoring method must meet the requirements in § 98.124(f)(1).

- (2) You must collect information on the number of each type of equipment; the service of each piece of equipment (gas, light liquid, heavy liquid); the concentration of each fluorinated GHG in the stream; and the time period each piece of equipment was in service. Depending on which approach you follow, you may be required to collect information for equipment on the associated screening data concentrations for greater than or equal to 10,000 ppmv and associated screening data concentrations for less than 10,000 ppmv; associated actual screening data concentrations; or associated screening data and leak rate data (i.e., bagging) used to develop a unit-specific correlation.
- (3) Calculate and sum the emissions of each fluorinated GHG in metric tons per year for equipment pieces for each process,  $E_{ELf}$ , annually. You must include and estimate emissions for types of equipment that are excluded from monitoring, including difficult-to-monitor, unsafe-to-monitor and insulated pieces of equipment, pieces of equipment in heavy liquid service, pumps with dual mechanical seals, agitators with dual mechanical seals, pumps with no external shaft, agitators with no external shaft, pressure relief devices in gas and vapor service with upstream rupture disk, sampling connection systems with closed-loop or closed purge systems, and pieces of equipment where leaks are routed through a closed vent system to a destruction device.

(e) **Calculate total fluorinated GHG emissions for each process and for production or transformation processes at the facility.**

- (1) Estimate annually the total mass of each fluorinated GHG emitted from each process, including emissions from process vents in paragraphs (c)(3) and (c)(4) of this section, as appropriate, and from equipment leaks in paragraph (d), using Equation L-29 of this section.

$$E_i = E_{Pfi} + E_{ELfi} \quad (\text{Eq. L-29})$$

where:

$E_i$  = Total mass of each fluorinated GHG  $f$  emitted from process  $i$ , annual basis (kg/year).

$E_{Pfi}$  = Mass of fluorinated GHG  $f$  emitted from all process vents and all operating scenarios in process  $i$ , annually (kg/year, calculated in Equation L-24 or L-28 of this section, as appropriate).

$E_{ELfi}$  = Mass of fluorinated GHG  $f$  emitted from equipment leaks for pieces of equipment for process  $i$ , annually (kg/year, calculated in paragraph (d)(3) of this section).

- (2) Estimate annually the total mass of each fluorinated GHG emitted from each type of production or transformation process at the facility using Equation L-30 of this section. Develop separate totals for fluorinated gas production processes, transformation processes that transform fluorinated gases produced at the facility, and transformation processes that transform fluorinated gases produced at another facility.

$$E = \sum_{i=1}^z E_i * 0.001 \quad (\text{Eq. L-30})$$

where:

E = Total mass of each fluorinated GHG f emitted from all fluorinated gas production processes, all transformation processes that transform fluorinated gases produced at the facility, or all transformation processes that transform fluorinated gases produced at another facility, as appropriate (metric tons).

E<sub>f</sub> = Total mass of each fluorinated GHG f emitted from each production or transformation process, annual basis (kg/year, calculated in Equation L-29 of this section).

0.001 = Conversion factor from kg to metric tons.

z = Total number of fluorinated gas production processes, fluorinated gas transformation processes that transform fluorinated gases produced at the facility, or transformation processes that transform fluorinated gases produced at another facility, as appropriate.

- (f) **Calculate fluorinated GHG emissions from destruction of fluorinated GHGs that were previously “produced”.** Estimate annually the total mass of fluorinated GHGs emitted from destruction of fluorinated GHGs that were previously “produced” as defined at § 98.410(b) using Equation L-31 of this section:

$$E_D = RE_D * (1 - DE) \quad (\text{Eq. L-31})$$

where:

E<sub>D</sub> = The mass of fluorinated GHGs emitted annually from destruction of fluorinated GHGs that were previously “produced” as defined at § 98.410(b) (metric tons).

RE<sub>D</sub> = The mass of fluorinated GHGs that were previously “produced” as defined at § 98.410(b) and that are fed annually into the destruction device (metric tons).

DE = Destruction efficiency of the destruction device (fraction).

- (g) **Emissions from venting of residual fluorinated GHGs in containers.** If you vent residual fluorinated GHGs from containers, you must either measure the residual fluorinated GHGs vented from each container or develop a heel factor for each combination of fluorinated GHG, container size, and container type that you vent. You do not need to estimate de minimis emissions associated with good-faith attempts to recycle or recover residual fluorinated GHGs in or from containers.

- (1) **Measuring contents of each container.** If you weigh or otherwise measure the contents of each container before venting the residual fluorinated GHGs, use Equation L-32 of this section to calculate annual emissions of each fluorinated GHG from venting of residual fluorinated GHG from containers. Convert pressures to masses as directed in paragraph (g)(2)(ii) of this section.

$$E_{Cf} = \sum_1^n H_{Bff} - \sum_1^n H_{Eff} \quad (\text{Eq. L-32})$$

Where:

E<sub>Cf</sub> = Total mass of each fluorinated GHG f emitted from the facility through venting of residual fluorinated GHG from containers, annual basis (metric tons/year).

$H_{Bfj}$  = Mass of residual fluorinated GHG f in container j when received by facility (metric tons).

$H_{E fj}$  = Mass of residual fluorinated GHG f in container j after evacuation by facility (metric tons). (Facility may equate to zero.)

n = Number of vented containers for each fluorinated GHG f.

(2) **Developing and applying heel factors.** If you use heel factors to estimate emissions of residual fluorinated GHGs vented from containers, you must annually develop these factors based on representative samples of the containers received by your facility from fluorinated GHG users.

(i) **Sample size.** For each combination of fluorinated GHG, container size, and container type that you vent, select a representative sample of containers that reflects the full range of quantities of residual gas returned in that container size and type. This sample must reflect the full range of the industries and a broad range of the customers that use and return the fluorinated GHG, container size, and container type. The minimum sample size for each combination of fluorinated GHG, container size, and container type must be 30, unless this is greater than the number of containers returned within that combination annually, in which case the contents of every container returned must be measured.

(ii) **Measurement of residual gas.** The residual weight or pressure you use for paragraph (g)(1) of this section must be determined by monitoring the mass or the pressure of your cylinders/containers according to § 98.124(k). If you monitor the pressure, convert the pressure to mass using a form of the ideal gas law, as displayed in Equation L-33 of this section, with an appropriately selected Z value.

$$m_R = \frac{p * V * MW}{Z * R * T * 10^6} \quad (\text{Eq. L-33})$$

Where:

$m_R$  = Mass of residual gas in the container (metric ton).

p = Absolute pressure of the gas (Pa).

V = Volume of the gas ( $m^3$ ).

MW = Molecular weight of the fluorinated GHG f (g/gmole).

Z = Compressibility factor.

R = Gas constant (8.314 Pa  $m^3$ /Kelvin mole).

T = Absolute temperature (K).

$10^6$  = Conversion factor ( $10^6$  g/metric ton).

- (iii) **Heel factor calculation.** To determine the heel factor  $h_{fj}$  for each combination of fluorinated GHG, container size, and container type, use paragraph (g)(1) of this section to calculate the total heel emissions for each sample selected under paragraph (g)(2)(i) of this section. Divide this total by the number of containers in the sample. Divide the result by the full capacity (the mass of the contents of a full container) of that combination of fluorinated GHG, container size, and container type. The heel factor is expressed as a fraction of the full capacity.
- (iv) Calculate annual emissions of each fluorinated GHG from venting of residual fluorinated GHG from containers using Equation L-34 of this section.

$$E_{Cf} = \sum_{j=1}^n h_{fj} * N_{fj} * F_{fj} \quad (\text{Eq. L-34})$$

Where:

$E_{Cf}$  = Total mass of each fluorinated GHG  $f$  emitted from the facility through venting of residual fluorinated GHG from containers, annual basis (metric tons/year).

$h_{fj}$  = Facility-wide gas-specific heel factor for fluorinated GHG  $f$  (fraction) and container size and type  $j$ , as determined in paragraph (g)(2)(iii) of this section.

$N_{fj}$  = Number of containers of size and type  $j$  returned to the fluorinated gas production facility.

$F_{fj}$  = Full capacity of containers of size and type  $j$  containing fluorinated GHG  $f$  (metric tons).

$n$  = Number of combinations of container sizes and types for fluorinated GHG  $f$ .

- (h) **Effective destruction efficiency for each process.** If you used the emission factor or emission calculation factor method to calculate emissions from the process, use Equation L-35 to calculate the effective destruction efficiency for the process, including each process vent:

$$DE_{Effective} = 1 - \frac{\sum_i \left( \sum_j E_{PVf} \right) \times GWP_f}{\sum_i \left( \sum_j ECF_{PV-Uf} \times (Activity_U + Activity_C) \right) \times GWP_f + \sum_i \left( \sum_j EF_{PV-Uf} \times (Activity_U + Activity_C) \right) \times GWP_f} \quad (\text{Eq. L-35})$$

Where:

$DE_{Effective}$  = Effective destruction efficiency for process  $i$  (fraction).

$E_{PVf}$  = Mass of fluorinated GHG  $f$  emitted from process vent  $v$  from process  $i$ , operating scenario  $j$ , for the year, calculated in Equation L-21, L-22, L-26, or L-27 of this section (kg).

$GWP_f$  = Global warming potential for each greenhouse gas from Table A-1 of subpart A of this part.

$ECF_{PV-Uf}$  = Emission calculation factor for fluorinated GHG  $f$  emitted from process vent  $v$  during process  $i$ , operating scenario  $j$  during periods when the process vent is not vented to the properly functioning destruction device, as used in Equation L-21; or emission calculation factor for fluorinated GHG  $f$  emitted from process vent  $v$  during process  $i$ , operating scenario  $j$ , as used in Equation L-26 or L-27 (kg emitted/activity) (e.g., kg emitted/kg product), denoted as " $ECF_{PV}$ " in those equations.

$EF_{PV-Uf}$  = Emission factor (uncontrolled) for fluorinated GHG  $f$  emitted from process vent  $v$  during process  $i$ , operating scenario  $j$ , as used in Equation L-22 (kg emitted/activity) (e.g., kg emitted/kg product), denoted as " $EF_{PV-U}$ " in that equation.

$Activity_U$  = Total process feed, process production, or other process activity for process  $i$ , operating scenario  $j$  during the year, for which the process vent is not vented to the properly functioning destruction device (i.e., uncontrolled).

$Activity_C$  = Total process feed, process production, or other process activity for process  $i$ , operating scenario  $j$  during the year, for which emissions are vented to the properly functioning destruction device (i.e., controlled).

$o$  = Number of operating scenarios for process  $i$ .

$v$  = Number of process vents in process  $i$ , operating scenario  $j$ .

$w$  = Number of fluorinated GHGs emitted from the process.

[75 FR 74831, Dec. 1, 2010, as amended at 79 FR 73785, Dec. 11, 2014]

## § 98.124 Monitoring and QA/QC requirements.

(a) **Initial scoping speciation to identify fluorinated GHGs.** You must conduct an initial scoping speciation to identify all fluorinated GHGs that may be generated from processes that are subject to this subpart and that have at least one process vent with uncontrolled emissions of 1.0 metric ton or more of fluorinated GHGs per year based on the preliminary estimate of emissions in § 98.123(c)(1). You are not required to quantify emissions under this initial scoping speciation. Only fluorinated GHG products and by-products that occur in greater than trace concentrations in at least one stream must be identified under this paragraph.

(1) **Procedure.** To conduct the scoping speciation, select the stream(s) (including process streams or destroyed streams) or process vent(s) that would be expected to individually or collectively contain all of the fluorinated GHG by-products of the process at their maximum concentrations and sample and analyze the contents of these selected streams or process vents. For example, if fluorinated GHG by-products are separated into one low-boiling-point and one high-boiling-point stream, sample and analyze both of these streams. Alternatively, you may sample and analyze streams where fluorinated GHG by-products occur at less than their maximum concentrations, but you must ensure that the sensitivity of the analysis is sufficient to compensate for the expected difference in concentration. For example, if you sample and analyze streams where fluorinated GHG by-products are expected to occur at one half their maximum concentrations elsewhere in the process, you must ensure that the sensitivity of the analysis is sufficient to detect fluorinated GHG by-products that occur at concentrations of 0.05 percent or higher. You do not have to sample and analyze every stream or process vent, i.e., you do not have to sample and analyze a stream or process vent that

contains only fluorinated GHGs that are contained in other streams or process vents that are being sampled and analyzed. Sampling and analysis must be conducted according to the procedures in paragraph (e) of this section.

(2) **Previous measurements.** If you have conducted testing of streams (including process streams or destroyed streams) or process vents less than 10 years before December 31, 2010, and the testing meets the requirements in paragraph (a)(1) of this section, you may use the previous testing to satisfy this requirement.

(b) **Mass balance monitoring.** Mass balance monitoring was available for reporting years 2011, 2012, 2013, and 2014 only. See paragraph 2 of Appendix A of this subpart for the former mass balance method.

(c) **Emission factor testing.** If you determine fluorinated GHG emissions using the site-specific process-vent-specific emission factor, you must meet the requirements in paragraphs (c)(1) through (c)(8) of this section.

(1) **Process vent testing.** Conduct an emissions test that is based on representative performance of the process or operating scenario(s) of the process, as applicable. For process vents for which you performed an initial scoping speciation, include in the emission test any fluorinated GHG that was identified in the initial scoping speciation. For process vents for which you did not perform an initial scoping speciation, include in the emission test any fluorinated greenhouse gas that occurs in more than trace concentrations in the vent stream or, where a destruction device is used, in the inlet to the destruction device. You may include startup and shutdown events if the testing is sufficiently long or comprehensive to ensure that such events are not overrepresented in the emission factor. Malfunction events must not be included in the testing. If you do not detect a fluorinated GHG that was identified in the scoping speciation or that occurs in more than trace concentrations in the vent stream or in the inlet to the destruction device, assume that fluorinated GHG was emitted at one half of the detection limit.

(2) **Number of runs.** For continuous processes, sample the process vent for a minimum of three runs of 1 hour each. If the relative standard deviation (RSD) of the emission factor calculated based on the first three runs is greater than or equal to 0.15 for the emission factor, continue to sample the process vent for an additional three runs of 1 hour each. If more than one fluorinated GHG is measured, the RSD must be expressed in terms of total CO<sub>2</sub>e.

(3) **Process activity measurements.** Determine the mass rate of process feed, process production, or other process activity as applicable during the test using flow meters, weigh scales, or other measurement devices or instruments with an accuracy and precision of  $\pm 1$  percent of full scale or better. These devices may be the same plant instruments or procedures that are used for accounting purposes (such as weigh hoppers, belt weigh feeders, combination of volume measurements and bulk density, etc.) if these devices or procedures meet the requirement. For monitoring ongoing process activity, use flow meters, weigh scales, or other measurement devices or instruments with an accuracy and precision of  $\pm 1$  percent of full scale or better.

(4) **Sample each process.** If process vents from separate processes are manifolded together to a common vent or to a common destruction device, you must follow paragraph (c)(4)(i), (c)(4)(ii), or (c)(4)(iii) of this section.

(i) You may sample emissions from each process in the ducts before the emissions are combined.

(ii) You may sample in the common duct or at the outlet of the destruction device when only one process is operating.

- (iii) You may sample the combined emissions and use engineering calculations and assessments as specified in § 98.123(c)(4) to allocate the emissions to each manifolded process vent, provided the sum of the calculated fluorinated GHG emissions across the individual process vents is within 20 percent of the total fluorinated GHG emissions measured during the manifolded testing.
- (5) **Emission test results.** The results of an emission test must include the analysis of samples, number of test runs, the results of the RSD analysis, the analytical method used, determination of emissions, the process activity, and raw data and must identify the process, the operating scenario, the process vents tested, and the fluorinated GHGs that were included in the test. The emissions test report must contain all information and data used to derive the process-vent-specific emission factor, as well as key process conditions during the test. Key process conditions include those that are normally monitored for process control purposes and may include but are not limited to yields, pressures, temperatures, etc. (e.g., of reactor vessels, distillation columns).
- (6) **Emissions testing frequency.** You must conduct emissions testing to develop the process-vent-specific emission factor under paragraph (c)(7)(i) or (c)(7)(ii) of this section, whichever occurs first:
  - (i) **10-year revision.** Conduct an emissions test every 10 years. In the calculations under § 98.123, apply the revised process-vent-specific emission factor to the process activity that occurs after the revision.
  - (ii) **Operating scenario change that affects the emission factor.** For planned operating scenario changes, you must estimate and compare the emission calculation factors for the changed operating scenario and for the original operating scenario whose process vent specific emission factor was measured. Use the calculation methods in § 98.123(c)(4). If the emission calculation factor for the changed operating scenario is 15 percent or more different from the emission calculation factor for the previous operating scenario (this includes the cumulative change in the emission calculation factor since the last emissions test), you must conduct an emissions test to update the process-vent-specific emission factor, unless the difference between the operating scenarios is solely due to the application of a destruction device to emissions under the changed operating scenario. Conduct the test before February 28 of the year that immediately follows the change. In the calculations under § 98.123, apply the revised process-vent-specific emission factor to the process activity that occurs after the operating scenario change.
- (7) **Subsequent measurements.** If a continuous process vent with fluorinated GHG emissions less than 10,000 metric tons CO<sub>2</sub>e, per § 98.123(c)(2), is later found to have fluorinated GHG emissions of 10,000 metric tons CO<sub>2</sub>e or greater, you must conduct the emissions testing for the process vent during the following year and develop the process-vent-specific emission factor from the emissions testing.
- (8) **Previous measurements.** If you have conducted an emissions test less than 10 years before December 31, 2010, and the emissions testing meets the requirements in paragraphs (c)(1) through (c)(8) of this section, you may use the previous emissions testing to develop process-vent-specific emission factors. For purposes of paragraph (c)(7)(i) of this section, the date of the previous emissions test rather than December 31, 2010 shall constitute the beginning of the 10-year re-measurement cycle.

- (d) **Emission calculation factor monitoring.** If you determine fluorinated GHG emissions using the site-specific process-vent-specific emission calculation factor, you must meet the requirements in paragraphs (d)(1) through (d)(4) of this section.
- (1) **Operating scenario.** Perform the emissions calculation for the process vent based on representative performance of the operating scenario of the process. If more than one operating scenario applies to the process that contains the subject process vent, you must conduct a separate emissions calculation for operation under each operating scenario. For each continuous process vent that contains more than trace concentrations of any fluorinated GHG and for each batch process vent that contains more than trace concentrations of any fluorinated GHG, develop the process-vent-specific emission calculation factor for each operating scenario. For continuous process vents, determine the emissions based on the process activity for the representative performance of the operating scenario. For batch process vents, determine emissions based on the process activity for each typical batch operating scenario.
  - (2) **Process activity measurements.** Use flow meters, weigh scales, or other measurement devices or instruments with an accuracy and precision of  $\pm 1$  percent of full scale or better for monitoring ongoing process activity.
  - (3) **Emission calculation results.** The emission calculation must be documented by identifying the process, the operating scenario, and the process vents. The documentation must contain the information and data used to calculate the process-vent-specific emission calculation factor.
  - (4) **Operating scenario change that affects the emission calculation factor.** For planned operating scenario changes that are expected to change the process-vent-specific emission calculation factor, you must conduct an emissions calculation to update the process-vent-specific emission calculation factor. In the calculations under § 98.123, apply the revised emission calculation factor to the process activity that occurs after the operating scenario change.
  - (5) **Previous calculations.** If you have performed an emissions calculation for the process vent and operating scenario less than 10 years before December 31, 2010, and the emissions calculation meets the requirements in paragraphs (d)(1) through (d)(4) of this section and in § 98.123(c)(4)(i) and (c)(4)(ii), you may use the previous calculation to develop the site-specific process-vent-specific emission calculation factor.
- (e) **Emission and stream testing, including analytical methods.** Select and document testing and analytical methods as follows:
- (1) **Sampling and mass measurement for emission testing.** For emission testing in process vents or at the stack, use methods for sampling, measuring volumetric flow rates, non-fluorinated-GHG gas analysis, and measuring stack gas moisture that have been validated using a scientifically sound validation protocol.
    - (i) Sample and velocity traverses. Acceptable methods include but are not limited to EPA Method 1 or 1A in Appendix A-1 of 40 CFR part 60.
    - (ii) Velocity and volumetric flow rates. Acceptable methods include but are not limited to EPA Method 2, 2A, 2B, 2C, 2D, 2F, or 2G in Appendix A-1 of 40 CFR part 60. Alternatives that may be used for determining flow rates include OTM-24 (incorporated by reference, see § 98.7) and ALT-012 (incorporated by reference, see § 98.7).



- (iii) Non-fluorinated-GHG gas analysis. Acceptable methods include but are not limited to EPA Method 3, 3A, or 3B in Appendix A-1 of 40 CFR part 60.
- (iv) Stack gas moisture. Acceptable methods include but are not limited to EPA Method 4 in Appendix A-1 of 40 CFR part 60.

(2) **Analytical methods.** Use a quality-assured analytical measurement technology capable of detecting the analyte of interest at the concentration of interest and use a sampling and analytical procedure validated with the analyte of interest at the concentration of interest. Where calibration standards for the analyte are not available, a chemically similar surrogate may be used. Acceptable analytical measurement technologies include but are not limited to gas chromatography (GC) with an appropriate detector, infrared (IR), fourier transform infrared (FTIR), and nuclear magnetic resonance (NMR). Acceptable methods for determining fluorinated GHGs include EPA Method 18 in appendix A-1 of 40 CFR part 60, EPA Method 320 in appendix A of 40 CFR part 63, EPA 430-R-10-003 (incorporated by reference, see § 98.7), ASTM D6348-03 (incorporated by reference, see § 98.7), or other analytical methods validated using EPA Method 301 at 40 CFR part 63, appendix A or some other scientifically sound validation protocol. Acceptable methods for determining total fluorine concentrations for fluorine-containing compounds in streams under paragraph (b)(3) of this section include ASTM D7359-08 (incorporated by reference, see § 98.7), or other analytical methods validated using EPA Method 301 at 40 CFR part 63, appendix A or some other scientifically sound validation protocol. The validation protocol may include analytical technology manufacturer specifications or recommendations.

(3) **Documentation in GHG Monitoring Plan.** Describe the sampling, measurement, and analytical method(s) used under paragraphs (e)(1) and (e)(2) of this section in the GHG Monitoring Plan as required under § 98.3(g)(5). Identify the methods used to obtain the samples and measurements listed under paragraphs (e)(1)(i) through (e)(1)(iv) of this section. At a minimum, include in the description of the analytical method a description of the analytical measurement equipment and procedures, quantitative estimates of the method's accuracy and precision for the analytes of interest at the concentrations of interest, as well as a description of how these accuracies and precisions were estimated, including the validation protocol used.

(f) **Emission monitoring for pieces of equipment.** If you conduct a site-specific leak detection method or monitoring approach for pieces of equipment, follow paragraph (f)(1) or (f)(2) of this section and follow paragraph (f)(3) of this section.

(1) **Site-specific leak monitoring approach.** You may develop a site-specific leak monitoring approach. You must validate the leak monitoring method and describe the method and the validation in the GHG Monitoring Plan. To validate the site-specific method, you may, for example, release a known rate of the fluorinated GHGs or surrogates of interest, or you may compare the results of the site-specific method to those of a method that has been validated for the fluorinated GHGs or surrogates of interest. In the description of the leak detection method and its validation, include a detailed description of the method, including the procedures and equipment used and any sampling strategies. Also include the rationale behind the method, including why the method is expected to result in an unbiased estimate of emissions from equipment leaks. If the method is based on methods that are used to detect or quantify leaks or other emissions in other regulations, standards, or guidelines, identify and describe the regulations, standards, or guidelines and why their methods are applicable to emissions of fluorinated GHGs or surrogates from leaks. Account for possible sources of error in the method, e.g., instrument detection limits, measurement biases, and sampling biases. Describe validation efforts, including but not limited to any comparisons against standard

leaks or concentrations, any comparisons against other methods, and their results. If you use the Screening Ranges Approach, the EPA Correlation Approach, or the Unit-Specific Correlation Approach with a monitoring instrument that does not meet all of the specifications in EPA Method 21 at 40 CFR part 60, appendix A-7, then explain how and why the monitoring instrument, as used at your facility, would nevertheless be expected to accurately detect and quantify emissions of fluorinated GHGs or surrogates from process equipment, and describe how you verified its accuracy. For all methods, provide a quantitative estimate of the accuracy and precision of the method.

- (2) **EPA Method 21 monitoring.** If you determine that EPA Method 21 at 40 CFR part 60, appendix A-7 is appropriate for monitoring a fluorinated GHG, conduct the screening value concentration measurements using EPA Method 21 at 40 CFR part 60, appendix A-7 to determine the screening range data or the actual screening value data for the Screening Ranges Approach, EPA Correlation Approach, or the Unit-Specific Correlation Approach. For the one-time testing to develop the Unit-Specific Correlation equations in EPA-453/R-95-017 (incorporated by reference, see § 98.7), conduct the screening value concentration measurements using EPA Method 21 at 40 CFR part 60, appendix A-7 and the bagging procedures to measure mass emissions. Concentration measurements of bagged samples must be conducted using gas chromatography following EPA Method 18 analytical procedures or other method according to § 98.124(e). Use methane or other appropriate compound as the calibration gas.
- (3) **Frequency of measurement and sampling.** If you estimate emissions based on monitoring of equipment, conduct monitoring at least annually. Sample at least one-third of equipment annually (except for equipment that is unsafe-to-monitor, difficult-to-monitor, insulated, or in heavy liquid service, pumps with dual mechanical seals, agitators with dual mechanical seals, pumps with no external shaft, agitators with no external shaft, pressure relief devices in gas and vapor service with an upstream rupture disk, sampling connection systems with closed-loop or closed purge systems, and pieces of equipment whose leaks are routed through a closed vent system to a destruction device), changing the sample each year such that at the end of three years, all equipment in the process has been monitored. If you estimate emissions based on a sample of the equipment in the process, ensure that the sample is representative of the equipment in the process. If you have multiple processes that have similar types of equipment in similar service, and that produce or transform similar fluorinated GHGs (in terms of chemical composition, molecular weight, and vapor pressure) at similar pressures and concentrations, then you may annually sample all of the equipment in one third of these processes rather than one third of the equipment in each process.
- (g) **Destruction device performance testing.** If you vent or otherwise feed fluorinated GHGs into a destruction device and apply the destruction efficiency of the device to one or more fluorinated GHGs in § 98.123, you must conduct emissions testing to determine the destruction efficiency for each fluorinated GHG to which you apply the destruction efficiency. You must either determine the destruction efficiency for the most-difficult-to-destroy fluorinated GHG fed into the device (or a surrogate that is still more difficult to destroy) and apply that destruction efficiency to all the fluorinated GHGs fed into the device or alternatively determine different destruction efficiencies for different groups of fluorinated GHGs using the most-difficult-to-destroy fluorinated GHG of each group (or a surrogate that is still more difficult to destroy).
- (1) **Destruction efficiency testing.** You must sample the inlet and outlet of the destruction device for a minimum of three runs of 1 hour each to determine the destruction efficiency. You must conduct the emissions testing using the methods in paragraph (e) of this section. To determine the destruction efficiency, emission testing must be conducted when operating at high loads reasonably expected to occur (i.e., representative of high total fluorinated GHG load that will be sent to the device) and when destroying the most-difficult-to-destroy fluorinated GHG (or a surrogate that is still more difficult to

destroy) that is fed into the device from the processes subject to this subpart or that belongs to the group of fluorinated GHGs for which you wish to establish a DE. If the outlet concentration of a fluorinated GHG that is fed into the device is below the detection limit of the method, you may use a concentration of one-half the detection limit to estimate the destruction efficiency.

- (i) If perfluoromethane (CF<sub>4</sub>) is vented to the destruction device in any stream in more than trace concentrations, you must test and determine the destruction efficiency achieved specifically for CF<sub>4</sub> to take credit for the CF<sub>4</sub> emissions reduction.
  - (ii) If sulfur hexafluoride (SF<sub>6</sub>) is vented to the destruction device in any stream in more than trace concentrations, you must test and determine the destruction efficiency achieved specifically for SF<sub>6</sub>, or alternatively for CF<sub>4</sub> as a surrogate, to take credit for the SF<sub>6</sub> emissions reduction.
  - (iii) If saturated perfluorocarbons other than CF<sub>4</sub> are vented to the destruction device in any stream in more than trace concentrations, you must test and determine the destruction efficiency achieved for the lowest molecular weight saturated perfluorocarbon vented to the destruction device, or alternatively for a lower molecular weight saturated PFC or SF<sub>6</sub> as a surrogate, to take credit for the PFC emission reduction.
  - (iv) For all other fluorinated GHGs that are vented to the destruction device in any stream in more than trace concentrations, you must test and determine the destruction efficiency achieved for the most-difficult-to-destroy fluorinated GHG or surrogate vented to the destruction device. Examples of acceptable surrogates include the Class 1 compounds (ranked 1 through 34) in Appendix D, Table D-1 of "Guidance on Setting Permit Conditions and Reporting Trial Burn Results; Volume II of the Hazardous Waste Incineration Guidance Series," January 1989, EPA Publication EPA 625/6-89/019. You can obtain a copy of this publication by contacting the Environmental Protection Agency, 1200 Pennsylvania Avenue, NW., Washington, DC 20460, (202) 272-0167, <http://www.epa.gov>.
- (2) ***Destruction efficiency testing frequency.*** You must conduct emissions testing to determine the destruction efficiency as provided in paragraphs (g)(2)(i) or (ii) of this section, whichever occurs first:
- (i) Conduct an emissions test every 10 years. In the calculations under § 98.123, apply the updated destruction efficiency to the destruction that occurs after the test.
  - (ii) ***Destruction device changes that affect the destruction efficiency.*** If you make a change to the destruction device that would be expected to affect the destruction efficiency, you must conduct an emissions test to update the destruction efficiency. Conduct the test before the February 28 of the year that immediately follows the change. In the calculations under § 98.123, apply the updated destruction efficiency to the destruction that occurs after the change to the device.
- (3) ***Previous testing.*** If you have conducted an emissions test within the 10 years prior to December 31, 2010, and the emissions testing meets the requirements in paragraph (g)(1) of this section, you may use the destruction efficiency determined during this previous emissions testing. For purposes of paragraph (g)(2)(i) of this section, the date of the previous emissions test rather than December 31, 2010 shall constitute the beginning of the 10-year re-measurement cycle.
- (4) ***Hazardous Waste Combustor testing.*** If a destruction device used to destroy fluorinated GHG is subject to subpart EEE of part 63 of this chapter or any portion of parts 260-270 of this chapter, you may apply the destruction efficiency specifically determined for CF<sub>4</sub>, SF<sub>6</sub>, PFCs other than CF<sub>4</sub>, and all other fluorinated GHGs under that test if the testing meets the criteria in paragraph (g)(1)(i)

through (g)(1)(iv) of this section. If the testing of the destruction efficiency under subpart EEE of part 63 of this chapter was conducted more than 10 years ago, you may use the most recent destruction efficiency test provided that the design, operation, or maintenance of the destruction device has not changed since the last destruction efficiency test in a manner that could affect the ability to achieve the destruction efficiency, and the hazardous waste is fed into the normal flame zone.

- (h) **Mass of previously produced fluorinated GHGs fed into destruction device.** You must measure the mass of each fluorinated GHG that is fed into the destruction device in more than trace concentrations and that was previously produced as defined at § 98.410(b). Such fluorinated GHGs include but are not limited to quantities that are shipped to the facility by another facility for destruction and quantities that are returned to the facility for reclamation but are found to be irretrievably contaminated and are therefore destroyed. You must use flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of  $\pm 1$  percent of full scale or better. If the measured mass includes more than trace concentrations of materials other than the fluorinated GHG being destroyed, you must measure the concentration of the fluorinated GHG being destroyed. You must multiply this concentration (mass fraction) by the mass measurement to obtain the mass of the fluorinated GHG fed into the destruction device.
- (i) **Emissions due to malfunctions of destruction device.** In their estimates of the mass of fluorinated GHG destroyed, fluorinated gas production facilities that destroy fluorinated GHGs must account for any temporary reductions in the destruction efficiency that result from any malfunctions of the destruction device, including periods of operation outside of the operating conditions defined in operating permit requirements and/or destruction device manufacturer specifications.
- (j) **Emissions due to process startup, shutdown, or malfunctions.** Fluorinated GHG production facilities must account for fluorinated GHG emissions that occur as a result of startups, shutdowns, and malfunctions, either recording fluorinated GHG emissions during these events, or documenting that these events do not result in significant fluorinated GHG emissions. Facilities may use the calculation methods in § 98.123(c)(1) to estimate emissions during startups, shutdowns, and malfunctions.
- (k) **Monitoring for venting residual fluorinated GHG in containers.** Measure the residual fluorinated GHG in containers received by the facility either using scales or using pressure and temperature measurements. You may use pressure and temperature measurements only in cases where no liquid fluorinated GHG is present in the container. Scales must have an accuracy and precision of  $\pm 1$  percent or better of the filled weight (gas plus tare) of the containers of fluorinated GHGs that are typically weighed on the scale. For example, for scales that are generally used to weigh cylinders that contain 115 pounds of gas when full and that have a tare weight of 115 pounds, this equates to  $\pm 1$  percent of 230 pounds, or  $\pm 2.3$  pounds. Pressure gauges and thermometers used to measure quantities that are monitored under this paragraph must have an accuracy and precision of  $\pm 1$  percent of full scale or better.
- (l) Initial scoping speciations, emissions testing, emission factor development, emission calculation factor development, emission characterization development, and destruction efficiency determinations must be completed by February 29, 2012 for processes and operating scenarios that operate between December 31, 2010 and December 31, 2011. For other processes and operating scenarios, initial scoping speciations, emissions testing, emission factor development, emission calculation factor development, emission characterization development, and destruction efficiency determinations must be complete by February 28 of the year following the year in which the process or operating scenario commences or recommences.

- (m) Calibrate all flow meters, weigh scales, and combinations of volumetric and density measures using monitoring instruments traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other recognized national measurement institute. Recalibrate all flow meters, weigh scales, and combinations of volumetric and density measures at the minimum frequency specified by the manufacturer. Use any of the following applicable flow meter test methods or the calibration procedures specified by the flow meter, weigh-scale, or other volumetric or density measure manufacturer.
  - (1) ASME MFC-3M-2004 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, see § 98.7).
  - (2) ASME MFC-4M-1986 (Reaffirmed 1997) Measurement of Gas Flow by Turbine Meters (incorporated by reference, see § 98.7).
  - (3) ASME-MFC-5M-1985, (Reaffirmed 1994) Measurement of Liquid Flow in Closed Conduits Using Transit-Time Ultrasonic Flowmeters (incorporated by reference, see § 98.7).
  - (4) ASME MFC-6M-1998 Measurement of Fluid Flow in Pipes Using Vortex Flowmeters (incorporated by reference, see § 98.7).
  - (5) ASME MFC-7M-1987 (Reaffirmed 1992) Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles (incorporated by reference, see § 98.7).
  - (6) ASME MFC-9M-1988 (Reaffirmed 2001) Measurement of Liquid Flow in Closed Conduits by Weighing Method (incorporated by reference, see § 98.7).
  - (7) ASME MFC-11M-2006 Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters (incorporated by reference, see § 98.7).
  - (8) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters (incorporated by reference, see § 98.7).
- (n) All analytical equipment used to determine the concentration of fluorinated GHGs, including but not limited to gas chromatographs and associated detectors, infrared (IR), fourier transform infrared (FTIR), and nuclear magnetic resonance (NMR) devices, must be calibrated at a frequency needed to support the type of analysis specified in the GHG Monitoring Plan as required under § 98.124(e)(3) and 93.3(g)(5). Quality assurance samples at the concentrations of concern must be used for the calibration. Such quality assurance samples must consist of or be prepared from certified standards of the analytes of concern where available; if not available, calibration must be performed by a method specified in the GHG Monitoring Plan.
- (o) Special provisions for estimating 2011 and subsequent year emissions.
  - (1) **Best available monitoring methods.** To estimate emissions that occur from January 1, 2011 through June 30, 2011, owners or operators may use best available monitoring methods for any parameter that cannot reasonably be measured according to the monitoring and QA/QC requirements of this subpart. The owner or operator must use the calculation methodologies and equations in § 98.123, but may use the best available monitoring method for any parameter for which it is not reasonably feasible to acquire, install, or operate a required piece of monitoring equipment, to procure measurement services from necessary providers, or to gain physical access to make required measurements in a facility by January 1, 2011. Starting no later than July 1, 2011, the owner or operator must discontinue using best available methods and begin following all applicable

monitoring and QA/QC requirements of this part, except as provided in paragraphs (o)(2) through (o)(4) of this section. Best available monitoring methods means any of the following methods specified in this paragraph:

- (i) Monitoring methods currently used by the facility that do not meet the specifications of this subpart.
  - (ii) Supplier data.
  - (iii) Engineering calculations or assessments.
  - (iv) Other company records.
- (2) ***Requests for extension of the use of best available monitoring methods to estimate 2011 emissions: parameters other than scoping speciations, emission factors, and emission characterizations.*** The owner or operator may submit a request to the Administrator to use one or more best available monitoring methods for parameters other than scoping speciations, emission factors, or emission characterizations to estimate emissions that occur between July 1, 2011 and December 31, 2011.
- (i) ***Timing of request.*** The extension request must be submitted to EPA no later than February 28, 2011.
  - (ii) ***Content of request.*** Requests must contain the following information:
    - (A) A list of specific items of monitoring equipment and measurement services for which the request is being made and the locations (e.g., processes and vents) where each piece of monitoring equipment will be installed and where each measurement service will be provided.
    - (B) Identification of the specific rule requirements for which the monitoring equipment or measurement service is needed.
    - (C) A description of the reasons why the needed equipment could not be obtained, installed, or operated or why the needed measurement service could not be provided before July 1, 2011. The owner or operator must consider all of the data collection and emission calculation options outlined in the rule for a specific emissions source before claiming that a specific safety, technical, logistical, or legal barrier exists.
    - (D) If the reason for the extension is that the equipment cannot be purchased, delivered, or installed before July 1, 2011, include supporting documentation such as the date the monitoring equipment was ordered, investigation of alternative suppliers, the dates by which alternative vendors promised delivery or installation, backorder notices or unexpected delays, descriptions of actions taken to expedite delivery or installation, and the current expected date of delivery or installation.
    - (E) If the reason for the extension is that service providers were unable to provide necessary measurement services, include supporting documentation demonstrating that these services could not be acquired before July 1, 2011. This documentation must include written correspondence to and from at least two service providers stating that they will not be able to provide the necessary services before July 1, 2011.
    - (F) If the reason for the extension is that the process is operating continuously without process shutdown, include supporting documentation showing that it is not practicable to isolate the process equipment or unit and install the measurement device without a full

shutdown or a hot tap, and that there is no opportunity before July 1, 2011 to install the device. Include the date of the three most recent shutdowns for each relevant process equipment or unit, the frequency of shutdowns for each relevant process equipment or unit, and the date of the next planned process equipment or unit shutdown.

- (G) If the reason for the extension is that access to process streams, emissions streams, or destroyed streams, as applicable, could not be gained before July 1, 2011 for reasons other than the continuous operation of the process without shutdown, include illustrative documentation such as photographs and engineering diagrams demonstrating that access could not be gained.
  - (H) A description of the best available monitoring methods that will be used and how their results will be applied (i.e., which calculation method will be used) to develop the emission estimate. Where the proposed best available monitoring method is the use of current monitoring data in the mass-balance approach, include the estimated relative and absolute errors of the mass-balance approach using the current monitoring data.
  - (I) A description of the specific actions the owner or operator will take to comply with monitoring requirements by January 1, 2012.
- (3) **Requests for extension of the use of best available monitoring methods to estimate 2011 emissions: scoping speciations, emission factors, and emission characterizations.** The owner or operator may submit a request to the Administrator to use one or more best available monitoring methods for scoping speciations, emission factors, and emission characterizations to estimate emissions that occur between July 1, 2011 and December 31, 2011.
- (i) **Timing of request.** The extension request must be submitted to EPA no later than June 30, 2011.
  - (ii) **Content of request.** Requests must contain the information outlined in paragraph (o)(2)(ii) of this section, substituting March 1, 2012 for July 1, 2011 and substituting March 1, 2013 for January 1, 2012.
  - (iii) **Reporting of 2011 emissions using scoping speciations, emission factors, and emission characterizations developed after February 29, 2012.** Facilities that are approved to use best available monitoring methods in 2011 for scoping speciations, emission factors, or emission characterizations for certain processes must submit, by March 31, 2013, revised 2011 emission estimates that reflect the scoping speciations, emission factors, and emission characterizations that are measured for those processes after February 29, 2012. If the operating scenario for 2011 is different from all of the operating scenarios for which emission factors are developed after February 29, 2012, use Equation L-23 at § 98.123(c)(3)(viii) to adjust the emission factor(s) or emission characterizations measured for the post-February 29, 2012 operating scenario(s) to account for the differences.
- (4) **Requests for extension of the use of best available monitoring methods to estimate emissions that occur after 2011.** EPA does not anticipate approving the use of best available monitoring methods to estimate emissions that occur beyond December 31, 2011; however, EPA reserves the right to review requests for unique and extreme circumstances which include safety, technical infeasibility, or inconsistency with other local, State or Federal regulations.
- (i) **Timing of request.** The extension request must be submitted to EPA no later than June 30, 2011.

(ii) **Content of request.** Requests must contain the following information:

- (A) The information outlined in paragraph (o)(2)(ii) of this section. For scoping speciations, emission factors, and emission characterizations, substitute March 1, 2013 for July 1, 2011 and substitute March 1, 2014 for January 1, 2012. For other parameters, substitute January 1, 2012 for July 1, 2011 and substitute January 1, 2013 for January 1, 2012.
- (B) A detailed outline of the unique circumstances necessitating an extension, including specific data collection issues that do not meet safety regulations, technical infeasibility or specific laws or regulations that conflict with data collection. The owner or operator must consider all the data collection and emission calculation options outlined in the rule for a specific emissions source before claiming that a specific safety, technical or legal barrier exists.
- (C) A detailed explanation and supporting documentation of how and when the owner or operator will receive the required data and/or services to comply with the reporting requirements of this subpart in the future.
- (E) The Administrator reserves the right to require that the owner or operator provide additional documentation.

(iii) **Reporting of 2011 and subsequent year emissions using scoping speciations, emission factors, and emission characterizations developed after approval to use best available monitoring methods expires.** Facilities that are approved to use best available monitoring methods in 2011 and subsequent years for scoping speciations, emission factors, or emission characterizations for certain processes must submit, by March 31 of the year that begins one year after their approval to use best available monitoring method(s) expires, revised emission estimates for 2011 and subsequent years that reflect the scoping speciations, emission factors, and emission characterizations that are measured for those processes in 2013 or subsequent years. If the operating scenario for 2011 or subsequent years is different from all of the operating scenarios for which emission factors or emission characterizations are developed in 2013 or subsequent years, use Equation L-23 of § 98.123(c)(3)(viii) to adjust the emission factor(s) or emission characterization(s) measured for the new operating scenario(s) to account for the differences.

- (5) **Approval criteria.** To obtain approval, the owner or operator must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, or operate the required piece of monitoring equipment, to procure measurement services from necessary providers, or to gain physical access to make required measurements in a facility according to the requirements of this subpart by the dates specified in paragraphs (o)(2), (3), and (4) of this section for any of the reasons described in paragraph (o)(2)(ii) of this section, or, for requests under paragraph (o)(4) of this section, any of the reasons described in paragraph (o)(4)(ii)(B) of this section.

[75 FR 74831, Dec. 1, 2010, as amended at 79 FR 73787, Dec. 11, 2014]



## § 98.125 Procedures for estimating missing data.

- (a) A complete record of all measured parameters used in the GHG emissions calculations in § 98.123 is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter must be used in the calculations as specified in the paragraphs (b) and (c) of this section. You must document and keep records of the procedures used for all such estimates.
- (b) For each missing value of the fluorinated GHG concentration or fluorine-containing compound concentration, the substitute data value must be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident.
- (c) For each missing value of the mass produced, fed into the production process, fed into the transformation process, or fed into destruction devices, the substitute value of that parameter must be a secondary mass measurement where such a measurement is available. For example, if the mass produced is usually measured with a flowmeter at the inlet to the day tank and that flowmeter fails to meet an accuracy or precision test, malfunctions, or is rendered inoperable, then the mass produced may be estimated by calculating the change in volume in the day tank and multiplying it by the density of the product. Where a secondary mass measurement is not available, the substitute value of the parameter must be an estimate based on a related parameter. For example, if a flowmeter measuring the mass fed into a destruction device is rendered inoperable, then the mass fed into the destruction device may be estimated using the production rate and the previously observed relationship between the production rate and the mass flow rate into the destruction device.

## § 98.126 Data reporting requirements.

- (a) *All facilities.* In addition to the information required by § 98.3(c), you must report the information in paragraphs (a)(2) through (6) of this section according to the schedule in paragraph (a)(1) of this section, except as otherwise provided in paragraph (j) of this section or in § 98.3(c)(4)(vii) and Table A-7 of subpart A of this part.
  - (1) *Frequency of reporting under paragraph (a) of this section.* The information in paragraphs (a)(2) through (6) of this section must be reported annually.
  - (2) *Generically-identified process.* For each production and transformation process at the facility, you must:
    - (i) Provide a number, letter, or other identifier for the process. This identifier must be consistent from year to year.
    - (ii) Indicate whether the process is a fluorinated gas production process, a fluorinated gas transformation process where no fluorinated GHG reactant is produced at another facility, or a fluorinated gas transformation process where one or more fluorinated GHG reactants are produced at another facility.
    - (iii) Indicate whether the process could be characterized as reaction, distillation, or packaging (include all that apply).
    - (iv) For each generically-identified process and each fluorinated GHG group, report the method(s) used to determine the mass emissions of that fluorinated GHG group from that process from vents (i.e., mass balance (for reporting years 2011, 2012, 2013, and 2014 only), process-vent-specific emission factor, or process-vent-specific emission calculation factor).

- (v) For each generically-identified process and each fluorinated GHG group, report the method(s) used to determine the mass emissions of that fluorinated GHG group from that process from equipment leaks, unless you used the mass balance method (for reporting years 2011, 2012, 2013, and 2014 only) for that process.
- (3) **Emissions from production and transformation processes, process level, multiple products.** If your facility produces more than one fluorinated gas product, for each generically-identified process and each fluorinated GHG group, you must report the total GWP-weighted emissions of all fluorinated GHGs in that group from the process, in metric tons CO<sub>2</sub>e.
- (4) **Emissions from production and transformation processes, facility level, multiple products.** If your facility produces more than one fluorinated gas product, you must report the information in paragraphs (a)(4)(i) and (ii) of this section, as applicable, for emissions from production and transformation processes.
  - (i) For each fluorinated GHG with emissions of 1,000 metric tons of CO<sub>2</sub>e or more from production and transformation processes, summed across the facility as a whole, you must report the total mass in metric tons of the fluorinated GHG emitted from production and transformation processes, summed across the facility as a whole. If the fluorinated GHG does not have a chemical-specific GWP in Table A-1 of subpart A, identify the fluorinated GHG group of which that fluorinated GHG is a member.
  - (ii) For all other fluorinated GHGs emitted from production and transformation processes, you must report the total GWP-weighted emissions from production and transformation processes of those fluorinated GHGs by fluorinated GHG group, summed across the facility as a whole, in metric tons of CO<sub>2</sub>e.
- (5) **Emissions from production and transformation processes, facility level, one product only.** If your facility produces only one fluorinated gas product, aggregate and report the total GWP-weighted emissions from production and transformation processes of fluorinated GHGs by fluorinated GHG group for the facility as a whole, in metric tons of CO<sub>2</sub>e, with the following exception: Where emissions consist of a major fluorinated GHG constituent of a fluorinated gas product, and the product is sold or transferred to another person, report the total mass in metric tons of each fluorinated GHG that is emitted from production and transformation processes and that is a major fluorinated GHG constituent of the product. If the fluorinated GHG does not have a chemical-specific GWP in Table A-1 of subpart A, identify the fluorinated GHG group of which that fluorinated GHG is a member.
- (6) **Effective destruction efficiency.** For each generically-identified process, use Table L-1 of this subpart to report the range that encompasses the effective destruction efficiency, DE<sub>effective</sub>, calculated for that process using Equation L-35 of this subpart. The effective destruction efficiency must be reported on a CO<sub>2</sub>e basis.
- (b) **Reporting for mass balance method for reporting years 2011, 2012, 2013, and 2014.** If you used the mass balance method to calculate emissions for any of the reporting years 2011, 2012, 2013, or 2014, you must conduct mass balance reporting for that reporting year. For processes whose emissions were determined using the mass balance method under the former § 98.123(b), as included in paragraph 1 of Appendix A of this subpart, you must report the information listed in paragraphs (b)(1) and (b)(2) of this section for each process on an annual basis.

- (1) If you calculated the relative and absolute errors under the former § 98.123(b)(1), the overall absolute and relative errors calculated for the process under the former § 98.123(b)(1), in metric tons CO<sub>2</sub>e and decimal fraction, respectively.
- (2) The method used to estimate the total mass of fluorine in destroyed or recaptured streams (specify the former § 98.123(b)(4) or (15), as included in paragraph 1 of Appendix A of this subpart).
- (c) **Reporting for emission factor and emission calculation factor approach.** For processes whose emissions are determined using the emission factor approach under § 98.123(c)(3) or the emission calculation factor under § 98.123(c)(4), you must report the following for each generically-identified process.
  - (1) [Reserved]
  - (2) [Reserved]
  - (3) For each fluorinated GHG group, the total GWP-weighted mass of all fluorinated GHGs in that group emitted from all process vents combined, in metric tons of CO<sub>2</sub>e.
  - (4) For each fluorinated GHG group, the total GWP-weighted mass of all fluorinated GHGs in that group emitted from equipment leaks, in metric tons of CO<sub>2</sub>e.
- (d) **Reporting for missing data.** Where missing data have been estimated pursuant to § 98.125, you must report:
  - (1) The generically-identified process for which the data were missing.
  - (2) The reason the data were missing, the length of time the data were missing, and the method used to estimate the missing data.
  - (3) Estimates of the missing data for all missing data associated with data elements required to be reported in this section.
- (e) **Reporting of destruction device excess emissions data.** Each fluorinated gas production facility that destroys fluorinated GHGs must report the excess emissions that result from malfunctions of the destruction device, and these excess emissions must be reflected in the fluorinated GHG estimates in the former § 98.123(b) as included in paragraph 1 of Appendix A of this subpart for the former mass balance method, and in § 98.123(c). Such excess emissions would occur if the destruction efficiency was reduced due to the malfunction.
- (f) **Reporting of destruction device testing.** By March 31, 2012 or by March 31 of the year immediately following the year in which it begins fluorinated GHG destruction, each fluorinated gas production facility that destroys fluorinated GHGs must submit a report containing the information in paragraphs (f)(1) through (f)(4) of this section. This report is one-time unless you make a change to the destruction device that would be expected to affect its destruction efficiencies.
  - (1) [Reserved]
  - (2) Chemical identity of the fluorinated GHG(s) used in the performance test conducted to determine destruction efficiency, including surrogates, and information on why the surrogate is sufficient to demonstrate the destruction efficiency for each fluorinated GHG, consistent with requirements in § 98.124(g)(1), vented to the destruction device.
  - (3) Date of the most recent destruction device test.
  - (4) Name of all applicable Federal or State regulations that may apply to the destruction process.

(5) [Reserved]

- (g) **Reporting for destruction of previously produced fluorinated GHGs.** Each fluorinated gas production facility that destroys fluorinated GHGs must report, separately from the fluorinated GHG emissions reported under paragraphs (b) or (c) of this section, the following for each previously produced fluorinated GHG destroyed:

(1) [Reserved]

(2) The mass of the fluorinated GHG emitted from the destruction device (metric tons).

- (h) **Reporting of emissions from venting of residual fluorinated GHGs from containers.** Each fluorinated gas production facility that vents residual fluorinated GHGs from containers must report the following for each fluorinated GHG vented:

(1) The mass of the residual fluorinated GHG vented from containers annually (metric tons).

(2) [Reserved]

- (i) **Reporting of fluorinated GHG products of incomplete combustion (PICs) of fluorinated gases.** Each fluorinated gas production facility that destroys fluorinated gases must submit a one-time report by June 30, 2011, that describes any measurements, research, or analysis that it has performed or obtained that relate to the formation of products of incomplete combustion that are fluorinated GHGs during the destruction of fluorinated gases. The report must include the methods and results of any measurement or modeling studies, including the products of incomplete combustion for which the exhaust stream was analyzed, as well as copies of relevant scientific papers, if available, or citations of the papers, if they are not. No new testing is required to fulfill this requirement.

- (j) **Special provisions for reporting years 2011, 2012, and 2013 only.** For reporting years 2011, 2012, and 2013, the owner or operator of a facility must comply with paragraphs (j)(1), (j)(2), and (j)(3) of this section.

(1) **Timing.** The owner or operator of a facility is not required to report the data elements at § 98.3(c)(4)(iii) and paragraphs (a)(2), (a)(3), (a)(4), (a)(6), (b), (c), (d), (e), (f), (g), and (h) of this section until the later of March 31, 2015 or the date set forth for that data element at § 98.3(c)(4)(vii) and Table A-7 of Subpart A of this part.

(2) **Excess emissions.** Excess emissions of fluorinated GHGs resulting from destruction device malfunctions must be reflected in the reported facility-wide CO<sub>2</sub>e emissions but are not required to be reported separately.

(3) **Calculation and reporting of CO<sub>2</sub>e.** You must report the total fluorinated GHG emissions covered by this subpart, expressed in metric tons of CO<sub>2</sub>e. This includes emissions from all fluorinated gas production processes, all fluorinated gas transformation processes that are not part of a fluorinated gas production process, all fluorinated gas destruction processes that are not part of a fluorinated gas production process or a fluorinated gas transformation process, and venting of residual fluorinated GHGs from containers returned from the field. To convert fluorinated GHG emissions to CO<sub>2</sub>e for reporting under this section, use Equation A-1 of § 98.2. For fluorinated GHGs whose GWPs are not listed in Table A-1 of Subpart A of this part, use either the default GWP specified below or your best estimate of the GWP based on the information described in § 98.123(c)(1)(vi)(A)(3). Use of quantitative structure activity relationships (QSARs) is an acceptable method for determining GWPs in situations where pure standards of the “target” fluorinated GHG are not available, the “target” fluorinated GHG cannot be isolated from gas streams, and FTIR spectra for the impurities are not available.

- (i) If you choose to use a default GWP rather than your best estimate of the GWP for fluorinated GHGs whose GWPs are not listed in Table A-1 of Subpart A of this part, use a default GWP of 10,000 for fluorinated GHGs that are fully fluorinated GHGs and use a default GWP of 2000 for other fluorinated GHGs.
  - (ii) Provide the total annual emissions across fluorinated GHGs for the entire facility, in metric tons of CO<sub>2</sub>e, that were calculated using the default GWP of 2000.
  - (iii) Provide the total annual emissions across fluorinated GHGs for the entire facility, in metric tons of CO<sub>2</sub>e, that were calculated using the default GWP of 10,000.
  - (iv) Provide the total annual emissions across fluorinated GHGs for the entire facility, in metric tons of CO<sub>2</sub>e, that were calculated using your best estimate of the GWP.
- (k) **Submission of complete reporting year 2011, 2012, and 2013 GHG reports.** By March 31, 2015, you must submit annual GHG reports for reporting years 2011, 2012, and 2013 that contain the information specified in paragraphs (a) through (i) of this section. The reports must calculate CO<sub>2</sub>e using the GWPs in Table A-1 of subpart A of this part (as in effect on January 1, 2015). Prior submission of partial reports for these reporting years under paragraph (j) of this section does not affect your obligation to submit complete reports under this paragraph.

[75 FR 74831, Dec. 1, 2010, as amended at 77 FR 51489, Aug. 24, 2012; 78 FR 71954, Nov. 29, 2013; 79 FR 73787, Dec. 11, 2014]

## § 98.127 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the dated records specified in paragraphs (a) through (l) of this section, as applicable.

- (a) **Process information records.**
  - (1) Identify all products and processes subject to this subpart. Include the unit identification as appropriate, the generic process identification reported for the process under § 98.126(a)(2)(i) through (iii), and the product with which the process is associated.
  - (2) Monthly and annual records, as applicable, of all analyses and calculations conducted as required under § 98.123, including the data monitored under § 98.124, and all information reported as required under § 98.126.
  - (3) Identify all fluorinated GHGs with emissions of 1,000 metric tons CO<sub>2</sub>e or more from production and transformation processes, summed across the facility as a whole, and identify all fluorinated GHGs with total emissions less than 1,000 metric tons CO<sub>2</sub>e from production and transformation processes, summed across the facility as a whole.
  - (4) Calculations used to determine the total GWP-weighted emissions of fluorinated GHGs by fluorinated GHG group for each process, in metric tons CO<sub>2</sub>e.
- (b) **Scoping speciation.** Retain records documenting the information collected under § 98.124(a).
- (c) **Mass balance method.** Retain the following records for each process for which the mass balance method was used to estimate emissions in reporting years 2011, 2012, 2013, or 2014. If you used an element other than fluorine in the mass balance equation pursuant to the former § 98.123(b)(3) as included in paragraph 1 of Appendix A of this subpart for the former mass balance method, substitute that element for fluorine in the recordkeeping requirements of this paragraph.

- (1) The data and calculations used to estimate the absolute and relative errors associated with use of the mass-balance approach.
  - (2) The data and calculations used to estimate the mass of fluorine emitted from the process.
  - (3) The data and calculations used to determine the fractions of the mass emitted consisting of each reactant (FER<sub>d</sub>), product (FEP), and by-product (FEB<sub>k</sub>), including the preliminary calculations in the former § 98.123(b)(8)(i).
- (d) **Emission factor and emission calculation factor method.** Retain the following records for each process for which the emission factor or emission calculation factor method was used to estimate emissions.
- (1) Identify all continuous process vents with emissions of fluorinated GHGs that are less than 10,000 metric tons CO<sub>2</sub>e per year and all continuous process vents with emissions of 10,000 metric tons CO<sub>2</sub>e per year or more. Include the data and calculation used to develop the preliminary estimate of emissions for each process vent.
  - (2) Identify all batch process vents.
  - (3) For each vent, identify the method used to develop the factor (i.e., emission factor by emissions test or emission calculation factor).
  - (4) The emissions test data and reports (see § 98.124(c)(5)) and the calculations used to determine the process-vent-specific emission factor, including the actual process-vent-specific emission factor, the average hourly emission rate of each fluorinated GHG from the process vent during the test and the process feed rate, process production rate, or other process activity rate during the test.
  - (5) The process-vent-specific emission calculation factor and the calculations used to determine the process-vent-specific emission calculation factor.
  - (6) The annual process production quantity or other process activity information in the appropriate units, along with the dates and time period during which the process was operating and dates and time periods the process vents are vented to the destruction device. As an alternative to date and time periods when process vents are vented to the destruction device, a facility may track dates and time periods that process vents by-pass the destruction device.
  - (7) Calculations used to determine annual emissions of each fluorinated GHG for each process and the total fluorinated GHG emissions for all processes, i.e., total for facility.
- (e) **Destruction efficiency testing.** A fluorinated GHG production facility that destroys fluorinated GHGs and reflects this destruction in § 98.123 must retain the emissions performance testing reports (including revised reports) for each destruction device. The emissions performance testing report must contain all information and data used to derive the destruction efficiency for each fluorinated GHG whose destruction the facility reflects in § 98.123, as well as the key process and device conditions during the test. This information includes the following:
- (1) Destruction efficiency (DE) determined for each fluorinated GHG whose destruction the facility reflects in § 98.123, in accordance with § 98.124(g)(1)(i) through (iv).
  - (2) Chemical identity of the fluorinated GHG(s) used in the performance test conducted to determine destruction efficiency, including surrogates, and information on why the surrogate is sufficient to demonstrate destruction efficiency for each fluorinated GHG, consistent with requirements in § 98.124(g)(1)(i) through (iv), vented to the destruction device.

- (3) Mass flow rate of the stream containing the fluorinated GHG(s) or surrogate into the device during the test.
  - (4) Concentration (mass fraction) of each fluorinated GHG or surrogate in the stream flowing into the device during the test.
  - (5) Concentration (mass fraction) of each fluorinated GHG or surrogate at the outlet of the destruction device during the test.
  - (6) Mass flow rate at the outlet of the destruction device during the test.
  - (7) Test methods and analytical methods used to determine the mass flow rates and fluorinated GHG (or surrogate) concentrations of the streams flowing into and out of the destruction device during the test.
  - (8) Destruction device conditions that are normally monitored for device control, such as temperature, total mass flow rates into the device, and CO or O<sub>2</sub> levels.
  - (9) Name of all applicable Federal or State regulations that may apply to the destruction process.
- (f) **Equipment leak records.** If you are subject to § 98.123(d) of this subpart, you must maintain information on the number of each type of equipment; the service of each piece of equipment (gas, light liquid, heavy liquid); the concentration of each fluorinated GHG in the stream; each piece of equipment excluded from monitoring requirement; the time period each piece of equipment was in service, and the emission calculations for each fluorinated GHG for all processes. Depending on which equipment leak monitoring approach you follow, you must maintain information for equipment on the associated screening data concentrations for greater than or equal to 10,000 ppmv and associated screening data concentrations for less than 10,000 ppmv; associated actual screening data concentrations; and associated screening data and leak rate data (i.e., bagging) used to develop a unit-specific correlation. If you developed and follow a site-specific leak detection approach, provide the records for monitoring events and the emissions estimation calculations, as appropriate, consistent with the approach for equipment leak emission estimation in your GHG Monitoring Plan.
- (g) **Container heel records.** If you vent residual fluorinated GHGs from containers, maintain the following records of the measurements and calculations used to estimate emissions of residual fluorinated GHGs from containers.
- (i) If you measure the contents of each container, maintain records of these measurements and the calculations used to estimate emissions of each fluorinated GHG from each container size and type.
  - (ii) If you develop and apply container heel factors to estimate emissions, maintain records of the measurements and calculations used to develop the heel factor for each fluorinated GHG and each container size and type and of the number of containers of each fluorinated GHG and of each container size and type returned to your facility.
- (h) **Missing data records.** Where missing data have been estimated pursuant to § 98.125, you must record the reason the data were missing, the length of time the data were missing, the method used to estimate the missing data, and the estimates of those data.
- (i) **All facilities.** Dated records documenting the initial and periodic calibration of all analytical equipment used to determine the concentration of fluorinated GHGs, including but not limited to gas chromatographs, gas chromatography-mass spectrometry (GC/MS), gas chromatograph-electron capture detector (GC/ECD), fourier transform infrared (FTIR), and nuclear magnetic resonance (NMR) devices, and

all mass measurement equipment such as weigh scales, flowmeters, and volumetric and density measures used to measure the quantities reported under this subpart, including the industry standards or manufacturer directions used for calibration pursuant to § 98.124(e), (f), (g), (m), and (n).

- (j) GHG Monitoring Plans, as described in § 98.3(g)(5), must be completed by April 1, 2011.
- (k) For fluorinated GHGs whose GWPs are not listed in Table A-1 to subpart A of this part, maintain records of the GWPs used to calculate facility-wide CO<sub>2</sub>e emissions under § 98.127(j). Where you used your best estimate of the GWP, maintain records of the data and analysis used to develop that GWP, including the data elements at § 98.123(c)(1)(vi)(A)(1) through (3). If you have used QSARs to estimate the GWP, include information documenting the level of accuracy of the QSAR-derived GWP, including information on how the structure of the “target” fluorinated GHG is similar to the structures of the fluorinated GHGs used to model the radiative forcing and/or reaction rate of the “target” fluorinated GHG, the quality and quantity of the measurements of the radiative forcings and/or reaction rates of the fluorinated GHGs used to model these parameters for the “target” fluorinated GHG, any estimated uncertainties of the modeled forcings and/or reaction rates, and descriptions and results of any efforts to validate the QSAR model(s).
- (l) **Verification software records.** For reporting year 2015 and thereafter, you must enter into verification software specified in § 98.5(b) the data specified in paragraphs (l)(1) through (15) of this section. The data specified in paragraphs (l)(1) through (11) must be entered for each process and each process vent, as applicable. The data specified in paragraphs (l)(1) through (15) must be entered for each fluorinated GHG, as applicable. You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (l)(1) through (15) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (l)(1) through (15) of this section.
  - (1) The identity of the process vent (e.g., name or number assigned by the facility).
  - (2) The equation used to estimate emissions from the process vent (Equations L-21, L-22, L-26, or L-27).
  - (3) The type of process activity used to estimate emissions from the process vent (e.g., product of process or reactant consumed by process) (Activity, Activity<sub>C</sub>, or Activity<sub>U</sub>) (Equations L-21, L-22, L-26, L-27, L-35).
  - (4) The quantities of the process activity used to estimate controlled and uncontrolled emissions, respectively, for the process vent, Activity, Activity<sub>U</sub>, or Activity<sub>C</sub>, (e.g. kg product) (Equations L-21, L-22, L-26, L-27, L-35).
  - (5) The site-specific, process-vent-specific emission factor, EF<sub>PV-C</sub>, for the process vent, measured after the destruction device (kg fluorinated GHG emitted per kg activity) (Equation L-21).
  - (6) The site-specific, process-vent-specific emission calculation factor, ECF<sub>PV-U</sub>, for the process vent, for periods not vented to destruction device (kg fluorinated GHG emitted per kg activity) (Equations L-21, L-35).
  - (7) The site-specific, process-vent-specific emission factor(s), EF<sub>PV-U</sub>, for the process vent, measured before the destruction device (kg fluorinated GHG emitted per kg activity) (Equations L-22, L-35).
  - (8) The site-specific, process-vent-specific emission calculation factor for the process vent, ECF<sub>PV</sub> (kg fluorinated GHG emitted per kg of activity) (Equations L-26, L-27, L-35).



- (9) Destruction efficiency, DE, of each destruction device for each fluorinated GHG whose destruction the facility reflects in § 98.123, in accordance with § 98.124(g)(1)(i) through (iv) (weight fraction) (Equations L-22, L-27, L-31).
- (10) Emissions of each fluorinated GHG for equipment pieces for the process,  $E_{ELf}$  (metric ton/yr) (98.123(d)(3)).
- (11) The mass of the fluorinated GHG previously produced and fed into the destruction device,  $RE_D$ , (metric tons) (Equation L-31).
- (12) If applicable, the heel factor,  $h_{fj}$ , calculated for each container size and type (decimal fraction) (Equation L-34).
- (13) If applicable, the number of containers of size and type j returned to the fluorinated gas production facility,  $N_{fj}$ , (Equation L-34).
- (14) If applicable, the full capacity of containers of size and type j containing fluorinated GHG f,  $F_{fj}$ , (metric tons) (Equation L-34).
- (15) For fluorinated GHGs that do not have a chemical-specific GWP on Table A-1 of subpart A of this part, the fluorinated GHG group of which the fluorinated GHG is a member, as applicable (to permit look-up of global warming potential,  $GWP_f$ , or  $GWP_i$ , for that fluorinated GHG in Table A-1 of subpart A of this part (Equation A-1 of subpart A of this part, Equation L-35)).

[75 FR 74831, Dec. 1, 2010, as amended at 77 FR 51490, Aug. 24, 2012; 79 FR 73788, Dec. 11, 2014]

## § 98.128 Definitions.

Except as provided in this section, all of the terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part. If a conflict exists between a definition provided in this subpart and a definition provided in subpart A, the definition in this subpart shall take precedence for the reporting requirements in this subpart.

**Batch process or batch operation** means a noncontinuous operation involving intermittent or discontinuous feed into equipment, and, in general, involves the emptying of the equipment after the batch operation ceases and prior to beginning a new operation. Addition of raw material and withdrawal of product do not occur simultaneously in a batch operation.

**Batch emission episode** means a discrete venting episode associated with a vessel in a process; a vessel may have more than one batch emission episode. For example, a displacement of vapor resulting from the charging of a vessel with a feed material will result in a discrete emission episode that will last through the duration of the charge and will have an average flow rate equal to the rate of the charge. If the vessel is then heated, there will also be another discrete emission episode resulting from the expulsion of expanded vapor. Other emission episodes also may occur from the same vessel and other vessels in the process, depending on process operations.

**By-product** means a chemical that is produced coincidentally during the production of another chemical.

**Completely destroyed** means destroyed with a destruction efficiency of 99.99 percent or greater.

**Completely recaptured** means 99.99 percent or greater of each fluorinated GHG is removed from a stream.

**Continuous process or operation** means a process where the inputs and outputs flow continuously throughout the duration of the process. Continuous processes are typically steady state.

**Destruction device** means any device used to destroy fluorinated GHG.

**Destruction process** means a process used to destroy fluorinated GHG in a destruction device such as a thermal incinerator or catalytic oxidizer.

**Difficult-to-monitor** means the equipment piece may not be monitored without elevating the monitoring personnel more than 2 meters (7 feet) above a support surface or it is not accessible in a safe manner when it is in fluorinated GHG service.

**Dual mechanical seal pump** and **dual mechanical seal agitator** means a pump or agitator equipped with a dual mechanical seal system that includes a barrier fluid system where the barrier fluid is not in light liquid service; each barrier fluid system is equipped with a sensor that will detect failure of the seal system, the barrier fluid system, or both; and meets the following requirements:

- (1) Each dual mechanical seal system is operated with the barrier fluid at a pressure that is at all times (except periods of startup, shutdown, or malfunction) greater than the pump or agitator stuffing box pressure; or
- (2) Equipped with a barrier fluid degassing reservoir that is routed to a process or fuel gas system or connected by a closed-vent system to a control device; or
- (3) Equipped with a closed-loop system that purges the barrier fluid into a process stream.

**Equipment** (for the purposes of § 98.123(d) and § 98.124(f) only) means each pump, compressor, agitator, pressure relief device, sampling connection system, open-ended valve or line, valve, connector, and instrumentation system in fluorinated GHG service for a process subject to this subpart; and any destruction devices or closed-vent systems to which processes subject to this subpart are vented.

**Fluorinated gas** means any fluorinated GHG, CFC, or HCFC.

**Fluorinated gas product** means the product of the process, including isolated intermediates.

**Fully fluorinated GHGs** means fluorinated GHGs that contain only single bonds and in which all available valence locations are filled by fluorine atoms. This includes but is not limited to saturated perfluorocarbons, SF<sub>6</sub>, NF<sub>3</sub>, SF<sub>5</sub>CF<sub>3</sub>, fully fluorinated linear, branched and cyclic alkanes, fully fluorinated ethers, fully fluorinated tertiary amines, fully fluorinated aminoethers, and perfluoropolyethers.

**Generically-identified process** means a process that is:

- (1) Identified as a production process, a transformation process where no fluorinated GHG reactant is produced at another facility, or a transformation process where one or more fluorinated GHG reactants are produced at another facility;
- (2) Further identified as a reaction, distillation, or packaging process, or a combination thereof; and
- (3) Tagged with a discrete identifier, such as a letter or number, that remains constant from year to year.

**In fluorinated GHG service** means that a piece of equipment either contains or contacts a feedstock, by-product, or product that is a liquid or gas and contains at least 5 percent by weight fluorinated GHG.

**In gas and vapor service** means that a piece of equipment in regulated material service contains a gas or vapor at operating conditions.

*In heavy liquid service* means that a piece of equipment in regulated material service is not in gas and vapor service or in light liquid service.

*In light liquid service* means that a piece of equipment in regulated material service contains a liquid that meets the following conditions:

- (1) The vapor pressure of one or more of the compounds is greater than 0.3 kilopascals at 20 °C.
- (2) The total concentration of the pure compounds constituents having a vapor pressure greater than 0.3 kilopascals at 20 °C is equal to or greater than 20 percent by weight of the total process stream.
- (3) The fluid is a liquid at operating conditions.

Note to definition of “in light liquid service”: Vapor pressures may be determined by standard reference texts or ASTM D-2879, (incorporated by reference, see § 98.7).

*In vacuum service* means that equipment is operating at an internal pressure which is at least 5 kilopascals below ambient pressure.

*Isolated intermediate* means a product of a process that is stored before subsequent processing. An isolated intermediate is usually a product of chemical synthesis. Storage of an isolated intermediate marks the end of a process. Storage occurs at any time the intermediate is placed in equipment used solely for storage.

*Major fluorinated GHG constituent* means a fluorinated GHG constituent of a fluorinated gas product that occurs in concentrations greater than 1 percent by mass.

*No external shaft pump* and *No external shaft agitator* means any pump or agitator that is designed with no externally actuated shaft penetrating the pump or agitator housing.

*Operating scenario* means any specific operation of a process and includes the information specified in paragraphs (1) through (5) of this definition for each process. A change or series of changes to any of these elements, except for paragraph (4) of this definition, constitutes a different operating scenario.

- (1) A description of the process, the specific process equipment used, and the range of operating conditions for the process.
- (2) An identification of related process vents, their associated emissions episodes and durations, and calculations and engineering analyses to show the annual uncontrolled fluorinated GHG emissions from the process vent.
- (3) The control or destruction devices used, as applicable, including a description of operating and/or testing conditions for any associated destruction device.
- (4) The process vents (including those from other processes) that are simultaneously routed to the control or destruction device(s).
- (5) The applicable monitoring requirements and any parametric level that assures destruction or removal for all emissions routed to the control or destruction device.

*Process* means all equipment that collectively functions to produce a fluorinated gas product, including an isolated intermediate (which is also a fluorinated gas product), or to transform a fluorinated gas product. A process may consist of one or more unit operations. For the purposes of this subpart, process includes any, all, or a combination of reaction, recovery, separation, purification, or other activity, operation,

manufacture, or treatment which are used to produce a fluorinated gas product. For a continuous process, cleaning operations conducted may be considered part of the process, at the discretion of the facility. For a batch process, cleaning operations are part of the process. Ancillary activities are not considered a process or part of any process under this subpart. Ancillary activities include boilers and incinerators, chillers and refrigeration systems, and other equipment and activities that are not directly involved (i.e., they operate within a closed system and materials are not combined with process fluids) in the processing of raw materials or the manufacturing of a fluorinated gas product.

**Process condenser** means a condenser whose primary purpose is to recover material as an integral part of a process. All condensers recovering condensate from a process vent at or above the boiling point or all condensers in line prior to a vacuum source are considered process condensers. Typically, a primary condenser or condensers in series are considered to be integral to the process if they are capable of and normally used for the purpose of recovering chemicals for fuel value (i.e., net positive heating value), use, reuse or for sale for fuel value, use, or reuse.

**Process vent** (for the purposes of this subpart only) means a vent from a process vessel or vents from multiple process vessels within a process that are manifolded together into a common header, through which a fluorinated GHG-containing gas stream is, or has the potential to be, released to the atmosphere (or the point of entry into a control device, if any). Examples of process vents include, but are not limited to, vents on condensers used for product recovery, bottoms receivers, surge control vessels, reactors, filters, centrifuges, and process tanks. Process vents do not include vents on storage tanks, wastewater emission sources, or pieces of equipment.

**Typical batch** means a batch process operated within a range of operating conditions that are documented in an operating scenario. Emissions from a typical batch are based on the operating conditions that result in representative emissions. The typical batch defines the uncontrolled emissions for each emission episode defined under the operating scenario.

**Uncontrolled fluorinated GHG emissions** means a gas stream containing fluorinated GHG which has exited the process (or process condenser or control condenser, where applicable), but which has not yet been introduced into a destruction device to reduce the mass of fluorinated GHG in the stream. If the emissions from the process are not routed to a destruction device, uncontrolled emissions are those fluorinated GHG emissions released to the atmosphere.

**Unsafe-to-monitor** means that monitoring personnel would be exposed to an immediate danger as a consequence of monitoring the piece of equipment. Examples of unsafe-to-monitor equipment include, but are not limited to, equipment under extreme pressure or heat.

[75 FR 74831, Dec. 1, 2010, as amended at 77 FR 51490, Aug. 24, 2012; 79 FR 73789, Dec. 11, 2014]

Table L-1 to Subpart L of Part 98—Ranges of Effective Destruction Efficiency

| Range of Reductions |
|---------------------|
| ≥99%.               |
| ≥95% to <99%.       |
| ≥75% to <95%.       |

| Range of Reductions |
|---------------------|
| ≥0% to <75%.        |

[79 FR 73789, Dec. 11, 2014]

## Appendix A to Subpart L of Part 98—Mass Balance Method for Fluorinated Gas Production

1. **Mass Balance Method for § 98.123(b).** [Note: Numbering convention here matches original rule text, 75 FR 74774, December 1, 2010.]

(b) **Mass balance method.** Before using the mass balance approach to estimate your fluorinated GHG emissions from a process, you must ensure that the process and the equipment and methods used to measure it meet either the error limits described in this paragraph and calculated under paragraph (b)(1) of this section or the requirements specified in paragraph § 98.124(b)(8). If you choose to calculate the error limits, you must estimate the absolute and relative errors associated with using the mass balance approach on that process using Equations L-1 through L-4 of this section in conjunction with Equations L-5 through L-10 of this section. You may use the mass-balance approach to estimate emissions from the process if this calculation results in an absolute error of less than or equal to 3,000 metric tons CO<sub>2</sub>e per year or a relative error of less than or equal to 30 percent of the estimated CO<sub>2</sub>e fluorinated GHG emissions. If you do not meet either of the error limits or the requirements of paragraph § 98.124(b)(8), you must use the emission factor approach detailed in paragraphs (c), (d), and (e) of this section to estimate emissions from the process.

(1) **Error calculation.** To perform the calculation, you must first calculate the absolute and relative errors associated with the quantities calculated using either Equations L-7 through L-10 of this section or Equation L-17 of this section. Alternatively, you may estimate these errors based on the variability of previous process measurements (e.g., the variability of measurements of stream concentrations), provided these measurements are representative of the current process and current measurement devices and techniques. Once errors have been calculated for the quantities in these equations, those errors must be used to calculate the errors in Equations L-6 and L-5 of this section. You may ignore the errors associated with Equations L-11, L-12, and L-13 of this section.

- (i) Where the measured quantity is a mass, the error in the mass must be equated to the accuracy or precision (whichever is larger) of the flowmeter, scale, or combination of volumetric and density measurements at the flow rate or mass measured.
- (ii) Where the measured quantity is a concentration of a stream component, the error of the concentration must be equated to the accuracy or precision (whichever is larger) with which you estimate the mean concentration of that stream component, accounting for the variability of the process, the frequency of the measurements, and the accuracy or precision (whichever is larger) of the analytical technique used to measure the concentration at the concentration measured. If the variability of process measurements is used to estimate the error, this variability shall be assumed to account both for the variability of the process and the precision of the analytical technique. Use standard

statistical techniques such as the student's t distribution to estimate the error of the mean of the concentration measurements as a function of process variability and frequency of measurement.

- (iii) Equation L-1 of this section provides the general formula for calculating the absolute errors of sums and differences where the sum, S, is the summation of variables measured, a, b, c, etc. (e.g.,  $S = a + b + c$ ):

$$e_{SA} = \left[ (a * e_a)^2 + (b * e_b)^2 + (c * e_c)^2 \right]^{1/2} \quad (\text{Eq. L-1})$$

Where:

$e_{SA}$  = Absolute error of the sum, expressed as one half of a 95 percent confidence interval.

$e_a$  = Relative error of a, expressed as one half of a 95 percent confidence interval.

$e_b$  = Relative error of b, expressed as one half of a 95 percent confidence interval.

$e_c$  = Relative error of c, expressed as one half of a 95 percent confidence interval.

- (iv) Equation L-2 of this section provides the general formula for calculating the relative errors of sums and differences:

$$e_{SR} = \frac{e_{SA}}{(a+b+c)} \quad (\text{Eq. L-2})$$

Where:

$e_{SR}$  = Relative error of the sum, expressed as one half of a 95 percent confidence interval.

$e_{SA}$  = Absolute error of the sum, expressed as one half of a 95 percent confidence interval.

$a + b + c$  = Sum of the variables measured.

- (v) Equation L-3 of this section provides the general formula for calculating the absolute errors of products (e.g., flow rates of GHGs calculated as the product of the flow rate of the stream and the concentration of the GHG in the stream), where the product, P, is the result of multiplying the variables measured, a, b, c, etc. (e.g.,  $P = a * b * c$ ):

$$e_{PA} = (a * b * c) (e_a^2 + e_b^2 + e_c^2)^{1/2} \quad (\text{Eq. L-3})$$

Where:

$e_{PA}$  = Absolute error of the product, expressed as one half of a 95 percent confidence interval.

$e_a$  = Relative error of a, expressed as one half of a 95 percent confidence interval.

$e_b$  = Relative error of b, expressed as one half of a 95 percent confidence interval.

$e_c$  = Relative error of c, expressed as one half of a 95 percent confidence interval.

- (vi) Equation L-4 of this section provides the general formula for calculating the relative errors of products:

$$e_{PR} = \frac{e_{PA}}{(a * b * c)} \quad (\text{Eq. L-4})$$

Where:

$e_{PR}$  = Relative error of the product, expressed as one half of a 95 percent confidence interval.

$e_{PA}$  = Absolute error of the product, expressed as one half of a 95 percent confidence interval.

$a*b*c$  = Product of the variables measured.

- (vii) Calculate the absolute error of the emissions estimate in terms of CO<sub>2</sub>e by performing a preliminary estimate of the annual CO<sub>2</sub>e emissions of the process using the method in paragraph (b)(1)(viii) of this section. Multiply this result by the relative error calculated for the mass of fluorine emitted from the process in Equation L-6 of this section.
- (viii) To estimate the annual CO<sub>2</sub>e emissions of the process for use in the error estimate, apply the methods set forth in paragraphs (b)(2) through (7) and (b)(9) through (16) of this section to representative process measurements. If these process measurements represent less than one year of typical process activity, adjust the estimated emissions to account for one year of typical process activity. To estimate the terms FER<sub>d</sub>, FEP, and FEB<sub>k</sub> for use in the error estimate for Equations L-11, L-12, and L-13 of this section, you must either use emission testing, monitoring of emitted streams, and/or engineering calculations or assessments, or in the alternative assume that all fluorine is emitted in the form of the fluorinated GHG that has the highest GWP among the fluorinated GHGs that occur in more than trace concentrations in the process. To convert the fluorinated GHG emissions to CO<sub>2</sub>e, use Equation A-1 of § 98.2. For fluorinated GHGs whose GWPs are not listed in Table A-1 to subpart A of this part, use a default GWP of 2,000.
- (2) The total mass of each fluorinated GHG emitted annually from each fluorinated gas production and each fluorinated GHG transformation process must be estimated by using Equation L-5 of this section.

$$E_{FGHGf} = \sum_{p=1}^n (E_{Rp-FGHGf} + E_{Pp-FGHGf} + E_{Bp-FGHGf}) \quad (\text{Eq. L-5})$$

Where:

$E_{FGHGf}$  = Total mass of each fluorinated GHG f emitted annually from production or transformation process i (metric tons).

$E_{Rp-FGHGf}$  = Total mass of fluorinated GHG reactant f emitted from production process i over the period p (metric tons, calculated in Equation L-11 of this section).

$E_{Pp-FGHGf}$  = Total mass of the fluorinated GHG product f emitted from production process i over the period p (metric tons, calculated in Equation L-12 of this section).

$E_{Bp-FGHGf}$  = Total mass of fluorinated GHG by-product f emitted from production process i over the period p (metric tons, calculated in Equation L-13 of this section).

n = Number of concentration and flow measurement periods for the year.

- (3) The total mass of fluorine emitted from process i over the period p must be estimated at least monthly by calculating the difference between the total mass of fluorine in the reactant(s) (or inputs, for processes that do not involve a chemical reaction) and the total mass of fluorine in the product (or outputs, for processes that do not involve a chemical reaction), accounting for the total mass of fluorine in any destroyed or recaptured streams that contain reactants, products, or by-products (or inputs or outputs). This calculation must be performed using Equation L-6 of this section. An element other than fluorine may be used in the mass-balance equation, provided the element occurs in all of the fluorinated GHGs fed into or generated by the process. In this case, the mass fractions of the element in the reactants, products, and by-products must be calculated as appropriate for that element.

$$E_F = \sum_1^v (R_d * MFF_{Rd}) - P * MFF_P - F_D \quad (\text{Eq. L-6})$$

Where:

$E_F$  = Total mass of fluorine emitted from process i over the period p (metric tons).

$R_d$  = Total mass of the fluorine-containing reactant d that is fed into process i over the period p (metric tons).

P = Total mass of the fluorine-containing product produced by process i over the period p (metric tons).

$MFF_{Rd}$  = Mass fraction of fluorine in reactant d, calculated in Equation L-14 of this section.

$MFF_P$  = Mass fraction of fluorine in the product, calculated in Equation L-15 of this section.

$F_D$  = Total mass of fluorine in destroyed or recaptured streams from process i containing fluorine-containing reactants, products, and by-products over the period p, calculated in Equation L-7 of this section.

v = Number of fluorine-containing reactants fed into process i.

- (4) The mass of total fluorine in destroyed or recaptured streams containing fluorine-containing reactants, products, and by-products must be estimated at least monthly using Equation L-7 of this section unless you use the alternative approach provided in paragraph (b)(15) of this section.

$$F_D = \sum_{j=1}^q P_j * MFF_P + \sum_{k=1}^n \left[ \left( \sum_{j=1}^q B_{kj} + \sum_{l=1}^x B_{kl} \right) * MFF_{Bk} \right] + \sum_{d=1}^v \left( \sum_{j=1}^q R_{dj} * MFF_{Rd} \right) \quad (\text{Eq. L-7})$$



Where:

$F_D$  = Total mass of fluorine in destroyed or recaptured streams from process i containing fluorine-containing reactants, products, and by-products over the period p.

$P_j$  = Mass of the fluorine-containing product removed from process i in stream j and destroyed over the period p (calculated in Equation L-8 or L-9 of this section).

$B_{kj}$  = Mass of fluorine-containing by-product k removed from process i in stream j and destroyed over the period p (calculated in Equation L-8 or L-9 of this section).

$B_{ki}$  = Mass of fluorine-containing by-product k removed from process i in stream i and recaptured over the period p.

$R_{dj}$  = Mass of fluorine-containing reactant d removed from process i in stream j and destroyed over the period p (calculated in Equation L-8 or L-9 of this section).

$MFF_{Rd}$  = Mass fraction of fluorine in reactant d, calculated in Equation L-14 of this section.

$MFF_P$  = Mass fraction of fluorine in the product, calculated in Equation L-15 of this section.

$MFF_{Bk}$  = Mass fraction of fluorine in by-product k, calculated in Equation L-16 of this section.

q = Number of streams destroyed in process i.

x = Number of streams recaptured in process i.

u = Number of fluorine-containing by-products generated in process i.

v = Number of fluorine-containing reactants fed into process i.

- (5) The mass of each fluorinated GHG removed from process i in stream j and destroyed over the period p (i.e.,  $P_j$ ,  $B_{kj}$ , or  $R_{dj}$ , as applicable) must be estimated by applying the destruction efficiency (DE) of the device that has been demonstrated for the fluorinated GHG f to fluorinated GHG f using Equation L-8 of this section:

$$M_{FGHGfj} = DE_{FGHGf} * C_{FGHGfj} * S_j \quad (\text{Eq. L-8})$$

Where:

$M_{FGHGfj}$  = Mass of fluorinated GHG f removed from process i in stream j and destroyed over the period p. (This may be  $P_j$ ,  $B_{kj}$ , or  $R_{dj}$ , as applicable.)

$DE_{FGHGf}$  = Destruction efficiency of the device that has been demonstrated for fluorinated GHG f in stream j (fraction).

$C_{FGHGfj}$  = Concentration (mass fraction) of fluorinated GHG f in stream j removed from process i and fed into the destruction device over the period p. If this concentration is only a trace concentration,  $C_{F-GHGfj}$  is equal to zero.

$S_j$  = Mass removed in stream j from process i and fed into the destruction device over the period p (metric tons).

- (6) The mass of each fluorine-containing compound that is not a fluorinated GHG and that is removed from process i in stream j and destroyed over the period p (i.e.,  $P_j$ ,  $B_{kj}$ , or  $R_{dj}$ , as applicable) must be estimated using Equation L-9 of this section.

$$M_{FCgj} = c_{FCgj} * S_j \quad (\text{Eq. L-9})$$

Where:

$M_{FCgj}$  = Mass of non-GHG fluorine-containing compound g removed from process i in stream j and destroyed over the period p. (This may be  $P_j$ ,  $B_{kj}$ , or  $R_{dj}$ , as applicable).

$c_{FCgj}$  = Concentration (mass fraction) of non-GHG fluorine-containing compound g in stream j removed from process i and fed into the destruction device over the period p. If this concentration is only a trace concentration,  $c_{FCgj}$  is equal to zero.

$S_j$  = Mass removed in stream j from process i and fed into the destruction device over the period p (metric tons).

- (7) The mass of fluorine-containing by-product k removed from process i in stream l and recaptured over the period p must be estimated using Equation L-10 of this section:

$$B_{kl} = c_{Bkl} * S_l \quad (\text{Eq. L-10})$$

Where:

$B_{kl}$  = Mass of fluorine-containing by-product k removed from process i in stream l and recaptured over the period p (metric tons).

$c_{Bkl}$  = Concentration (mass fraction) of fluorine-containing by-product k in stream l removed from process i and recaptured over the period p. If this concentration is only a trace concentration,  $c_{Bkl}$  is equal to zero.

$S_l$  = Mass removed in stream l from process i and recaptured over the period p (metric tons).

- (8) To estimate the terms  $FER_d$ ,  $FEP$ , and  $FEB_k$  for Equations L-11, L-12, and L-13 of this section, you must assume that the total mass of fluorine emitted,  $E_F$ , estimated in Equation L-6 of this section, occurs in the form of the fluorinated GHG that has the highest GWP among the fluorinated GHGs that occur in more than trace concentrations in the process unless you possess emission characterization measurements showing otherwise. These emission characterization measurements must meet the requirements in paragraph (8)(i), (ii), or (iii) of this section, as appropriate. The sum of the terms must equal 1. You must document the data and calculations that are used to speciate individual compounds and to estimate  $FER_d$ ,  $FEP$ , and  $FEB_k$ . Exclude from your calculations the fluorine included in  $F_D$ . For example, exclude fluorine-containing compounds that are not fluorinated GHGs and that result from the destruction of fluorinated GHGs by any destruction devices (e.g., the mass of HF created by combustion of an HFC). However, include emissions of fluorinated GHGs that survive the destruction process.

- (i) If the calculations under paragraph (b)(1)(viii) of this section, or any subsequent measurements and calculations under this subpart, indicate that the process emits 25,000 metric tons CO<sub>2</sub>e or more, estimate the emissions from each process vent, considering controls, using the methods in § 98.123(c)(1). You must characterize the emissions of any process vent that emits 25,000 metric tons CO<sub>2</sub>e or more as specified in § 98.124(b)(4).
  - (ii) For other vents, including vents from processes that emit less than 25,000 metric tons CO<sub>2</sub>e, you must characterize emissions as specified in § 98.124(b)(5).
  - (iii) For fluorine emissions that are not accounted for by vent estimates, you must characterize emissions as specified in § 98.124(b)(6).
- (9) The total mass of fluorine-containing reactant d emitted must be estimated at least monthly based on the total fluorine emitted and the fraction that consists of fluorine-containing reactants using Equation L-11 of this section. If the fluorine-containing reactant d is a non-GHG, you may assume that FER<sub>d</sub> is zero.

$$E_{R-ip} = \frac{FER_d * E_F}{\left( \sum_{d=1}^v FER_d * MFF_{Rd} + FEP * MFF_P + \sum_{k=1}^u FEB_k * MFF_{Bk} \right)} \quad (\text{Eq. L-11})$$

Where:

E<sub>R-ip</sub> = Total mass of fluorine-containing reactant d that is emitted from process i over the period p (metric tons).

FER<sub>d</sub> = The fraction of the mass emitted that consists of the fluorine-containing reactant d.

E<sub>F</sub> = Total mass of fluorine emissions from process i over the period p (metric tons), calculated in Equation L-6 of this section.

FEP = The fraction of the mass emitted that consists of the fluorine-containing product.

FEB<sub>k</sub> = The fraction of the mass emitted that consists of fluorine-containing by-product k.

MFF<sub>Rd</sub> = Mass fraction of fluorine in reactant d, calculated in Equation L-14 of this section.

MFF<sub>P</sub> = Mass fraction of fluorine in the product, calculated in Equation L-15 of this section.

MFF<sub>Bk</sub> = Mass fraction of fluorine in by-product k, calculation in Equation L-16 of this section.

u = Number of fluorine-containing by-products generated in process i.

v = Number of fluorine-containing reactants fed into process i.

- (10) The total mass of fluorine-containing product emitted must be estimated at least monthly based on the total fluorine emitted and the fraction that consists of fluorine-containing products using Equation L-12 of this section. If the fluorine-containing product is a non-GHG, you may assume that FEP is zero.

$$E_{P-ip} = \frac{FEP * E_F}{\left( \sum_{d=1}^v FER_d * MFF_{Rd} + FEP * MFF_P + \sum_{k=1}^u FEB_k * MFF_{Bk} \right)} \quad (\text{Eq. L-12})$$

Where:

$E_{P-ip}$  = Total mass of fluorine-containing product emitted from process i over the period p (metric tons).

FEP = The fraction of the mass emitted that consists of the fluorine-containing product.

$E_F$  = Total mass of fluorine emissions from process i over the period p (metric tons), calculated in Equation L-6 of this section.

$FER_d$  = The fraction of the mass emitted that consists of fluorine-containing reactant d.

$FEB_k$  = The fraction of the mass emitted that consists of fluorine-containing by-product k.

$MFF_{Rd}$  = Mass fraction of fluorine in reactant d, calculated in Equation L-14 of this section.

$MFF_P$  = Mass fraction of fluorine in the product, calculated in Equation L-15 of this section.

$MFF_{Bk}$  = Mass fraction of fluorine in by-product k, calculation in Equation L-16 of this section.

u = Number of fluorine-containing by-products generated in process i.

v = Number of fluorine-containing reactants fed into process i.

- (11) The total mass of fluorine-containing by-product k emitted must be estimated at least monthly based on the total fluorine emitted and the fraction that consists of fluorine-containing by-products using Equation L-13 of this section. If fluorine-containing by-product k is a non-GHG, you may assume that  $FEB_k$  is zero.

$$E_{Bk-ip} = \frac{FEB_k * E_F}{\left( \sum_{d=1}^v FER_d * MFF_{Rd} + FEP * MFF_P + \sum_{k=1}^u FEB_k * MFF_{Bk} \right)} \quad (\text{Eq. L-13})$$

Where:

$E_{Bk-ip}$  = Total mass of fluorine-containing by-product k emitted from process i over the period p (metric tons).

$FEB_k$  = The fraction of the mass emitted that consists of fluorine-containing by-product k.

$FER_d$  = The fraction of the mass emitted that consists of fluorine-containing reactant d.

FEP = The fraction of the mass emitted that consists of the fluorine-containing product.

$E_F$  = Total mass of fluorine emissions from process i over the period p (metric tons), calculated in Equation L-6 of this section.

$MFF_{Rd}$  = Mass fraction of fluorine in reactant d, calculated in Equation L-14 of this section.

$MFF_P$  = Mass fraction of fluorine in the product, calculated in Equation L-15 of this section.

$MFF_{Bk}$  = Mass fraction of fluorine in by-product k, calculation in Equation L-16 of this section.

u = Number of fluorine-containing by-products generated in process i.

v = Number of fluorine-containing reactants fed into process i.

- (12) The mass fraction of fluorine in reactant d must be estimated using Equation L-14 of this section:

$$MFF_{Rd} = MF_{Rd} * \frac{AW_F}{MW_{Rd}} \quad (\text{Eq. L-14})$$

Where:

$MFF_{Rd}$  = Mass fraction of fluorine in reactant d (fraction).

$MF_{Rd}$  = Moles fluorine per mole of reactant d.

$AW_F$  = Atomic weight of fluorine.

$MW_{Rd}$  = Molecular weight of reactant d.

- (13) The mass fraction of fluorine in the product must be estimated using Equation L-15 of this section:

$$MFF_P = MF_P * \frac{AW_F}{MW_P} \quad (\text{Eq. L-15})$$

Where:

$MFF_P$  = Mass fraction of fluorine in the product (fraction).

$MF_P$  = Moles fluorine per mole of product.

$AW_F$  = Atomic weight of fluorine.

$MW_P$  = Molecular weight of the product produced.

- (14) The mass fraction of fluorine in by-product k must be estimated using Equation L-16 of this section:

$$MFF_{Bk} = MF_{Bk} * \frac{AW_F}{MW_{Bk}} \quad (\text{Eq. L-16})$$

Where:

$MFF_{Bk}$  = Mass fraction of fluorine in the product (fraction).

$MF_{Bk}$  = Moles fluorine per mole of by-product k.

$AW_F$  = Atomic weight of fluorine.

$MW_{Bk}$  = Molecular weight of by-product k.

- (15) Alternative for determining the mass of fluorine destroyed or recaptured. As an alternative to using Equation L-7 of this section as provided in paragraph (b)(4) of this section, you may estimate at least monthly the total mass of fluorine in destroyed or recaptured streams containing fluorine-containing compounds (including all fluorine-containing reactants, products, and byproducts) using Equation L-17 of this section.

$$F_D = \sum_{j=1}^q DE_{avgj} * c_{TFj} * S_j + \sum_{l=1}^x c_{TFI} * S_l \quad (\text{Eq. L-17})$$

Where:

$F_D$  = Total mass of fluorine in destroyed or recaptured streams from process i containing fluorine-containing reactants, products, and by-products over the period p.

$DE_{avgj}$  = Weighted average destruction efficiency of the destruction device for the fluorine-containing compounds identified in destroyed stream j under § 98.124(b)(4)(ii) and (5)(ii) (calculated in Equation L-18 of this section)(fraction).

$c_{TFj}$  = Concentration (mass fraction) of total fluorine in stream j removed from process i and fed into the destruction device over the period p. If this concentration is only a trace concentration,  $c_{TFj}$  is equal to zero.

$S_j$  = Mass removed in stream j from process i and fed into the destruction device over the period p (metric tons).

$c_{TFI}$  = Concentration (mass fraction) of total fluorine in stream I removed from process i and recaptured over the period p. If this concentration is only a trace concentration,  $c_{Bkl}$  is equal to zero.

$S_l$  = Mass removed in stream I from process i and recaptured over the period p.

q = Number of streams destroyed in process i.

x = Number of streams recaptured in process i.

- (16) Weighted average destruction efficiency. For purposes of Equation L-17 of this section, calculate the weighted average destruction efficiency applicable to a destroyed stream using Equation L-18 of this section.

$$DE_{avgj} = \frac{\sum_{f=1}^w DE_{FGHGf} * c_{FGHGf} * S_j * MFF_{FGHGf} + \sum_{g=1}^y c_{FCg} * S_j * MFF_g}{\sum_{f=1}^w c_{FGHGf} * S_j * MFF_{FGHGf} + \sum_{g=1}^y c_{FCg} * S_j * MFF_g} \quad (\text{Eq. L-18})$$

Where:

$DE_{avgj}$  = Weighted average destruction efficiency of the destruction device for the fluorine-containing compounds identified in destroyed stream j under 98.124(b)(4)(ii) or (b)(5)(ii), as appropriate.

$DE_{FGHGf}$  = Destruction efficiency of the device that has been demonstrated for fluorinated GHG f in stream j (fraction).

$c_{FGHGfj}$  = Concentration (mass fraction) of fluorinated GHG f in stream j removed from process i and fed into the destruction device over the period p. If this concentration is only a trace concentration,  $c_{F-GHGfj}$  is equal to zero.

$c_{FCgj}$  = Concentration (mass fraction) of non-GHG fluorine-containing compound g in stream j removed from process i and fed into the destruction device over the period p. If this concentration is only a trace concentration,  $c_{FCgj}$  is equal to zero.

$S_j$  = Mass removed in stream j from process i and fed into the destruction device over the period p (metric tons).

$MFF_{FGHGf}$  = Mass fraction of fluorine in fluorinated GHG f, calculated in Equation L-14, L-15, or L-16 of this section, as appropriate.

$MFF_{FCg}$  = Mass fraction of fluorine in non-GHG fluorine-containing compound g, calculated in Equation L-14, L-15, or L-16 of this section, as appropriate.

w = Number of fluorinated GHGs in destroyed stream j.

y = Number of non-GHG fluorine-containing compounds in destroyed stream j.

2. **Mass Balance Method for § 98.124(b).** [Note: Numbering convention here matches original rule text, 75 FR 74774, December 1, 2010.]

- (b) **Mass balance monitoring.** If you determine fluorinated GHG emissions from any process using the mass balance method under § 98.123(b), you must estimate the total mass of each fluorinated GHG emitted from that process at least monthly. Only streams that contain greater than trace concentrations of fluorine-containing reactants, products, or by-products must be monitored under this paragraph. If you use an element other than fluorine in the mass-balance equation pursuant to § 98.123(b)(3), substitute that element for fluorine in the monitoring requirements of this paragraph.

- (1) **Mass measurements.** Measure the following masses on a monthly or more frequent basis using flowmeters, weigh scales, or a combination of volumetric and density measurements with accuracies and precisions that allow the facility to meet the error criteria in § 98.123(b)(1):
  - (i) Total mass of each fluorine-containing product produced. Account for any used fluorine-containing product added into the production process upstream of the output measurement as directed at §§ 98.413(b) and 98.414(b). For each product, the mass produced used for the mass-balance calculation must be the same as the mass produced that is reported under subpart OO of this part, where applicable.
  - (ii) Total mass of each fluorine-containing reactant fed into the process.
  - (iii) The mass removed from the process in each stream fed into the destruction device.
  - (iv) The mass removed from the process in each recaptured stream.
- (2) **Concentration measurements for use with § 98.123(b)(4).** If you use § 98.123(b)(4) to estimate the mass of fluorine in destroyed or recaptured streams, measure the following concentrations at least once each calendar month during which the process is operating, on a schedule to ensure that the measurements are representative of the full range of process conditions (e.g., catalyst age). Measure more frequently if this is necessary to meet the error criteria in § 98.123(b)(1). Use equipment and methods (e.g., gas chromatography) that comply with paragraph (e) of this section and that have an accuracy and precision that allow the facility to meet the error criteria in § 98.123(b)(1). Only fluorine-containing reactants, products, and by-products that occur in a stream in greater than trace concentrations must be monitored under this paragraph.
  - (i) The concentration (mass fraction) of the fluorine-containing product in each stream that is fed into the destruction device.
  - (ii) The concentration (mass fraction) of each fluorine-containing by-product in each stream that is fed into the destruction device.
  - (iii) The concentration (mass fraction) of each fluorine-containing reactant in each stream that is fed into the destruction device.
  - (iv) The concentration (mass fraction) of each fluorine-containing by-product in each stream that is recaptured ( $C_{Bkl}$ ).
- (3) **Concentration measurements for use with § 98.123(b)(15).** If you use § 98.123(b)(15) to estimate the mass of fluorine in destroyed or recaptured streams, measure the concentrations listed in paragraphs (b)(3)(i) and (ii) of this section at least once each calendar month during which the process is operating, on a schedule to ensure that the measurements are representative of the full range of process conditions (e.g., catalyst age). Measure more frequently if this is necessary to meet the error criteria in § 98.123(b)(1). Use equipment and methods (e.g., gas chromatography) that comply with paragraph (e) of this section and that have an accuracy and precision that allow the facility to meet the error criteria in § 98.123(b)(1). Only fluorine-containing reactants, products, and by-products that occur in a stream in greater than trace concentrations must be monitored under this paragraph.
  - (i) The concentration (mass fraction) of total fluorine in each stream that is fed into the destruction device.



(ii) The concentration (mass fraction) of total fluorine in each stream that is recaptured.

- (4) **Emissions characterization: process vents emitting 25,000 metric tons CO<sub>2</sub>e or more.** To characterize emissions from any process vent emitting 25,000 metric tons CO<sub>2</sub>e or more, comply with paragraphs (b)(4)(i) through (b)(4)(v) of this section, as appropriate. Only fluorine-containing reactants, products, and by-products that occur in a stream in greater than trace concentrations must be monitored under this paragraph.
- (i) **Uncontrolled emissions.** If emissions from the process vent are not routed through a destruction device, sample and analyze emissions at the process vent or stack or sample and analyze emitted streams before the process vent. If the process has more than one operating scenario, you must either perform the emission characterization for each operating scenario or perform the emission characterization for the operating scenario that is expected to have the largest emissions and adjust the emission characterization for other scenarios using engineering calculations and assessments as specified in § 98.123(c)(4). To perform the characterization, take three samples under conditions that are representative for the operating scenario. Measure the concentration of each fluorine-containing compound in each sample. Use equipment and methods that comply with paragraph (e) of this section. Calculate the average concentration of each fluorine-containing compound across all three samples.
- (ii) **Controlled emissions using § 98.123(b)(15).** If you use § 98.123(b)(15) to estimate the total mass of fluorine in destroyed or recaptured streams, and if the emissions from the process vent are routed through a destruction device, characterize emissions as specified in paragraph (b)(4)(i) of this section before the destruction device. Apply the destruction efficiency demonstrated for each fluorinated GHG in the destroyed stream to that fluorinated GHG. Exclude from the characterization fluorine-containing compounds that are not fluorinated GHGs.
- (iii) **Controlled emissions using § 98.123(b)(4).** If you use § 98.123(b)(4) to estimate the mass of fluorine in destroyed or recaptured streams, and if the emissions from the process vent are routed through a destruction device, characterize the process vent's emissions monthly (or more frequently) using the monthly (or more frequent) measurements under paragraphs (b)(1)(iii) and (b)(2)(i) through (iii) of this section. Apply the destruction efficiency demonstrated for each fluorinated GHG in the destroyed stream to that fluorinated GHG. Exclude from the characterization fluorine-containing compounds that are not fluorinated GHGs.
- (iv) **Emissions characterization frequency.** You must repeat emission characterizations performed under paragraph (b)(4)(i) and (ii) of this section under paragraph (b)(4)(iv)(A) or (B) of this section, whichever occurs first:
- (A) **10-year revision.** Repeat the emission characterization every 10 years. In the calculations under § 98.123, apply the revised emission characterization to the process activity that occurs after the revision.
- (B) **Operating scenario change that affects the emission characterization.** For planned operating scenario changes, you must estimate and compare the emission calculation factors for the changed operating scenario and for the original operating scenario whose process vent specific emission factor was measured. Use the engineering calculations and assessments specified in § 98.123(c)(4). If the share of

total fluorine-containing compound emissions represented by any fluorinated GHG changes under the changed operating scenario by 15 percent or more of the total, relative to the previous operating scenario (this includes the cumulative change in the emission calculation factor since the last emissions test), you must repeat the emission characterization. Perform the emission characterization before February 28 of the year that immediately follows the change. In the calculations under § 98.123, apply the revised emission characterization to the process activity that occurs after the operating scenario change.

- (v) **Subsequent measurements.** If a process vent with fluorinated GHG emissions less than 25,000 metric tons CO<sub>2</sub>e, per § 98.123(c)(2), is later found to have fluorinated GHG emissions of 25,000 metric tons CO<sub>2</sub>e or greater, you must perform an emission characterization under this paragraph during the following year.
- (5) **Emissions characterization: Process vents emitting less than 25,000 metric tons CO<sub>2</sub>e.** To characterize emissions from any process vent emitting less than 25,000 metric tons CO<sub>2</sub>e, comply with paragraphs (b)(5)(i) through (iii) of this section, as appropriate. Only fluorine-containing reactants, products, and by-products that occur in a stream in greater than trace concentrations must be monitored under this paragraph.
  - (i) **Uncontrolled emissions.** If emissions from the process vent are not routed through a destruction device, emission measurements must consist of sampling and analysis of emissions at the process vent or stack, sampling and analysis of emitted streams before the process vent, previous test results, provided the tests are representative of current operating conditions of the process, or bench-scale or pilot-scale test data representative of the process operating conditions.
  - (ii) **Controlled emissions using § 98.123(b)(15).** If you use § 98.123(b)(15) to estimate the total mass of fluorine in destroyed or recaptured streams, and if the emissions from the process vent are routed through a destruction device, characterize emissions as specified in paragraph (b)(5)(i) of this section before the destruction device. Apply the destruction efficiency demonstrated for each fluorinated GHG in the destroyed stream to that fluorinated GHG. Exclude from the characterization fluorine-containing compounds that are not fluorinated GHGs.
  - (iii) **Controlled emissions using § 98.123(b)(4).** If you use § 98.123(b)(4) to estimate the mass of fluorine in destroyed or recaptured streams, and if the emissions from the process vent are routed through a destruction device, characterize the process vent's emissions monthly (or more frequently) using the monthly (or more frequent) measurements under paragraphs (b)(1)(iii) and (b)(2)(i) through (iii) of this section. Apply the destruction efficiency demonstrated for each fluorinated GHG in the destroyed stream to that fluorinated GHG. Exclude from the characterization fluorine-containing compounds that are not fluorinated GHGs.
- (6) **Emissions characterization: Emissions not accounted for by process vent estimates.** Calculate the weighted average emission characterization across the process vents before any destruction devices. Apply the weighted average emission characterization for all the process vents to any fluorine emissions that are not accounted for by process vent estimates.

- (7) **Impurities in reactants.** If any fluorine-containing impurity is fed into a process along with a reactant (or other input) in greater than trace concentrations, this impurity shall be monitored under this section and included in the calculations under § 98.123 in the same manner as reactants fed into the process, fed into the destruction device, recaptured, or emitted, except the concentration of the impurity in the mass fed into the process shall be measured, and the mass of the impurity fed into the process shall be calculated as the product of the concentration of the impurity and the mass fed into the process. The mass of the reactant fed into the process may be reduced to account for the mass of the impurity.
- (8) **Alternative to error calculation.** As an alternative to calculating the relative and absolute errors associated with the estimate of emissions under § 98.123(b), you may comply with the precision, accuracy, measurement and calculation frequency, and fluorinated GHG throughput requirements of paragraph (b)(8)(i) through (iv) of this section.
- (i) **Mass measurements.** Measure the masses specified in paragraph (b)(1) of this section using flowmeters, weigh scales, or a combination of volumetric and density measurements with accuracies and precisions of  $\pm 0.2$  percent of full scale or better.
- (ii) **Concentration measurements.** Measure the concentrations specified in paragraph (b)(2) or (3) of this section, as applicable, using analytical methods with accuracies and precisions of  $\pm 10$  percent or better.
- (iii) **Measurement and calculation frequency.** Perform the mass measurements specified in paragraph (b)(1) of this section and the concentration measurements specified in paragraph (b)(2) or (3) of this section, as applicable, at least weekly, and calculate emissions at least weekly.
- (iv) **Fluorinated-GHG throughput limit.** You may use the alternative to the error calculation specified in paragraph (b)(8) of this section only if the total annual CO<sub>2</sub>-equivalent fluorinated GHG throughput of the process is 500,000 mtCO<sub>2</sub>e or less. The total throughput is the sum of the masses of the fluorinated GHG reactants, products, and by-products fed into and generated by the process. To convert these masses to CO<sub>2</sub>e, use Equation A-1 of § 98.2. For fluorinated GHGs whose GWPs are not listed in Table A-1 to subpart A of this part, use a default GWP of 2,000.

[79 FR 73789, Dec. 11, 2014]

## Subpart M [Reserved]

## Subpart N—Glass Production

### § 98.140 Definition of the source category.

- (a) A glass manufacturing facility manufactures flat glass, container glass, pressed and blown glass, or wool fiberglass by melting a mixture of raw materials to produce molten glass and form the molten glass into sheets, containers, fibers, or other shapes. A glass manufacturing facility uses one or more continuous glass melting furnaces to produce glass.
- (b) A glass melting furnace that is an experimental furnace or a research and development process unit is not subject to this subpart.

### § 98.141 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a glass production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.142 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from each continuous glass melting furnace.
- (b) CO<sub>2</sub> combustion emissions from each continuous glass melting furnace.
- (c) CH<sub>4</sub> and N<sub>2</sub>O combustion emissions from each continuous glass melting furnace. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (d) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary fuel combustion unit other than continuous glass melting furnaces. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

### § 98.143 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each continuous glass melting furnace using the procedure in paragraphs (a) through (c) of this section.

- (a) For each continuous glass melting furnace that meets the conditions specified in § 98.33(b)(4)(ii) or (iii), you must calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) For each continuous glass melting furnace that is not subject to the requirements in paragraph (a) of this section, calculate and report the process and combustion CO<sub>2</sub> emissions from the glass melting furnace by using either the procedure in paragraph (b)(1) of this section or the procedure in paragraph (b)(2) of this section, except as specified in paragraph (c) of this section.
  - (1) Calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
  - (2) Calculate and report the process and combustion CO<sub>2</sub> emissions separately using the procedures specified in paragraphs (b)(2)(i) through (b)(2)(vi) of this section.
    - (i) For each carbonate-based raw material charged to the furnace, obtain from the supplier of the raw material the carbonate-based mineral mass fraction.
    - (ii) Determine the quantity of each carbonate-based raw material charged to the furnace.
    - (iii) Apply the appropriate emission factor for each carbonate-based raw material charged to the furnace, as shown in Table N-1 to this subpart.
    - (iv) Use Equation N-1 of this section to calculate process mass emissions of CO<sub>2</sub> for each furnace:

$$E_{CO_2} = \sum_{i=1}^n MF_i \left( M_i \frac{2000}{2205} \right) EF_i F_i \quad (\text{Eq. N-1})$$

Where:

$E_{CO_2}$  = Process emissions of  $CO_2$  from the furnace (metric tons).

$n$  = Number of carbonate-based raw materials charged to furnace.

$MF_i$  = Annual average decimal mass fraction of carbonate-based mineral  $i$  in carbonate-based raw material  $i$ .

$M_i$  = Annual amount of carbonate-based raw material  $i$  charged to furnace (tons).

$2000/2205$  = Conversion factor to convert tons to metric tons.

$EF_i$  = Emission factor for carbonate-based raw material  $i$  (metric ton  $CO_2$  per metric ton carbonate-based raw material as shown in Table N-1 to this subpart).

$F_i$  = Decimal fraction of calcination achieved for carbonate-based raw material  $i$ , assumed to be equal to 1.0.

- (v) You must calculate the total process  $CO_2$  emissions from continuous glass melting furnaces at the facility using Equation N-2 of this section:

$$CO_2 = \sum_{i=1}^k E_{CO_2i} \quad (\text{Eq. N-2})$$

Where:

$CO_2$  = Annual process  $CO_2$  emissions from glass manufacturing facility (metric tons).

$E_{CO_2i}$  = Annual  $CO_2$  emissions from glass melting furnace  $i$  (metric tons).

$k$  = Number of continuous glass melting furnaces.

- (vi) Calculate and report under subpart C of this part (General Stationary Fuel Combustion Sources) the combustion  $CO_2$  emissions in the glass furnace according to the applicable requirements in subpart C.

- (c) As an alternative to data provided by the raw material supplier, a value of 1.0 can be used for the mass fraction ( $MF_i$ ) of carbonate-based mineral  $i$  in Equation N-1 of this section.

[75 FR 74831, Dec. 1, 2010, as amended at 78 FR 71954, Nov. 29, 2013]

## § 98.144 Monitoring and QA/QC requirements.

- (a) You must measure annual amounts of carbonate-based raw materials charged to each continuous glass melting furnace from monthly measurements using plant instruments used for accounting purposes, such as calibrated scales or weigh hoppers. Total annual mass charged to glass melting furnaces at the facility shall be compared to records of raw material purchases for the year.
- (b) Unless you use the default value of 1.0, you must measure carbonate-based mineral mass fractions at least annually to verify the mass fraction data provided by the supplier of the raw material; such measurements shall be based on sampling and chemical analysis using consensus standards that specify X-ray fluorescence. For measurements made in years prior to the emissions reporting year 2014, you may also use ASTM D3682-01 (Reapproved 2006) Standard Test Method for Major and Minor Elements in Combustion Residues from Coal Utilization Processes or ASTM D6349-09 Standard Test Method for Determination of Major and Minor Elements in Coal, Coke, and Solid Residues from Combustion of Coal and Coke by Inductively Coupled Plasma—Atomic Emission Spectrometry (both incorporated by reference, see § 98.7).
- (c) Unless you use the default value of 1.0, you must determine the annual average mass fraction for the carbonate-based mineral in each carbonate-based raw material by calculating an arithmetic average of the monthly data obtained from raw material suppliers or sampling and chemical analysis.
- (d) Unless you use the default value of 1.0, you must determine on an annual basis the calcination fraction for each carbonate consumed based on sampling and chemical analysis using an industry consensus standard. If performed, this chemical analysis must be conducted using an x-ray fluorescence test or other enhanced testing method published by an industry consensus standards organization (e.g., ASTM, ASME, API, etc.).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66462, Oct. 28, 2010; 78 FR 71954, Nov. 29, 2013; 81 FR 89257, Dec. 9, 2016]

## § 98.145 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required (e.g., carbonate raw materials consumed, etc.). If the monitoring and quality assurance procedures in § 98.144 cannot be followed and data is missing, you must use the most appropriate of the missing data procedures in paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such missing value estimates.

- (a) For missing data on the monthly amounts of carbonate-based raw materials charged to any continuous glass melting furnace use the best available estimate(s) of the parameter(s), based on all available process data or data used for accounting purposes, such as purchase records.
- (b) For missing data on the mass fractions of carbonate-based minerals in the carbonate-based raw materials assume that the mass fraction of each carbonate based mineral is 1.0.

## § 98.146 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) and (b) of this section, as applicable.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required under § 98.36 for the Tier 4 Calculation Methodology and the following information specified in paragraphs (a)(1) through (3) of this section:

- (1) Annual quantity of each carbonate-based raw material (tons) charged to each continuous glass melting furnace and for all furnaces combined.
- (2) Annual quantity of glass produced (tons), by glass type, from each continuous glass melting furnace and from all furnaces combined.
- (3) Annual quantity (tons), by glass type, of recycled scrap glass (cullet) charged to each continuous glass melting furnace and for all furnaces combined.
- (b) If a CEMS is not used to determine CO<sub>2</sub> emissions from continuous glass melting furnaces, and process CO<sub>2</sub> emissions are calculated according to the procedures specified in § 98.143(b), then you must report the following information as specified in paragraphs (b)(1) through (9) of this section:
  - (1) Annual process emissions of CO<sub>2</sub> (metric tons) for each continuous glass melting furnace and for all furnaces combined.
  - (2) Annual quantity of each carbonate-based raw material charged (tons) to all furnaces combined.
  - (3) Annual quantity of glass produced (tons), by glass type, from each continuous glass melting furnace and from all furnaces combined.
  - (4) Annual quantity (tons), by glass type, of recycled scrap glass (cullet) charged to each continuous glass melting furnace and for all furnaces combined.
  - (5) Results of all tests, if applicable, used to verify the carbonate-based mineral mass fraction for each carbonate-based raw material charged to a continuous glass melting furnace, as specified in paragraphs (b)(5)(i) through (iii) of this section.
    - (i) Date of test.
    - (ii) Method(s) and any variations used in the analyses.
    - (iii) Mass fraction of each sample analyzed.
  - (6) [Reserved]
  - (7) Method used to determine decimal fraction of calcination, unless you used the default value of 1.0.
  - (8) Total number of continuous glass melting furnaces.
  - (9) The number of times in the reporting year that missing data procedures were followed to measure monthly quantities of carbonate-based raw materials, recycled scrap glass (cullet), or mass fraction of the carbonate-based minerals for any continuous glass melting furnace (months).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66462, Oct. 28, 2010; 78 FR 71954, Nov. 29, 2013; 79 FR 63786, Oct. 24, 2014; 81 FR 89257, Dec. 9, 2016; 89 FR 31925, Apr. 25, 2024]

### § 98.147 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the records listed in paragraphs (a) through (d) of this section.

- (a) If a CEMS is used to measure emissions, then you must retain the records required under § 98.37 for the Tier 4 Calculation Methodology and the following information specified in paragraphs (a)(1) through (3) of this section:

- (1) Monthly glass production rate for each continuous glass melting furnace, by glass type (tons).
  - (2) Monthly amount of each carbonate-based raw material charged to each continuous glass melting furnace (tons).
  - (3) Monthly amount (tons) of recycled scrap glass (cullet) charged to each continuous glass melting furnace, by glass type.
- (b) If process CO<sub>2</sub> emissions are calculated according to the procedures specified in § 98.143(b), you must retain the records in paragraphs (b)(1) through (6) of this section.
- (1) Monthly glass production rate for each continuous glass melting furnace, by glass type (tons).
  - (2) Monthly amount of each carbonate-based raw material charged to each continuous glass melting furnace (tons).
  - (3) Monthly amount (tons) of recycled scrap glass (cullet) charged to each continuous glass melting furnace, by glass type.
  - (4) Data on carbonate-based mineral mass fractions provided by the raw material supplier for all raw materials consumed annually and included in calculating process emissions in equation N-1 to § 98.143, if applicable.
  - (5) Results of all tests, if applicable, used to verify the carbonate-based mineral mass fraction for each carbonate-based raw material charged to a continuous glass melting furnace, including the data specified in paragraphs (b)(5)(i) through (v) of this section.
    - (i) Date of test.
    - (ii) Method(s), and any variations of the methods, used in the analyses.
    - (iii) Mass fraction of each sample analyzed.
    - (iv) Relevant calibration data for the instrument(s) used in the analyses.
    - (v) Name and address of laboratory that conducted the tests.
  - (6) The decimal fraction of calcination achieved for each carbonate-based raw material, if a value other than 1.0 is used to calculate process mass emissions of CO<sub>2</sub>.
- (c) All other documentation used to support the reported GHG emissions.
- (d) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (3) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (3) of this section.
- (1) Annual average decimal mass fraction of carbonate-based mineral in each carbonate-based raw material for each continuous glass melting furnace (specify the default value, if used, or the value determined according to § 98.144) (percentage, expressed as a decimal) (Equation N-1 of § 98.143).
  - (2) Annual amount of each carbonate-based raw material charged to each continuous glass melting furnace (tons) (Equation N-1 of this subpart).
  - (3) Decimal fraction of calcination achieved for each carbonate-based raw material for each continuous glass melting furnace (specify the default value, if used, or the value determined according to § 98.144) (percentage, expressed as a decimal) (Equation N-1 of this subpart).



[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71954, Nov. 29, 2013; 79 FR 63786, Oct. 24, 2014; 81 FR 89257, Dec. 9, 2016; 89 FR 31925, Apr. 25, 2024]

## § 98.148 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Table N-1 to Subpart N of Part 98—CO<sub>2</sub> Emission Factors for Carbonate-Based Raw Materials**

| Carbonate-based<br>raw material—mineral                   | CO <sub>2</sub> emission factor <sup>a</sup> |
|-----------------------------------------------------------|----------------------------------------------|
| Limestone—CaCO <sub>3</sub>                               | 0.440                                        |
| Dolomite—CaMg(CO <sub>3</sub> ) <sub>2</sub>              | 0.477                                        |
| Sodium carbonate/soda ash—Na <sub>2</sub> CO <sub>3</sub> | 0.415                                        |
| Barium carbonate—BaCO <sub>3</sub>                        | 0.223                                        |
| Potassium carbonate—K <sub>2</sub> CO <sub>3</sub>        | 0.318                                        |
| Lithium carbonate (Li <sub>2</sub> CO <sub>3</sub> )      | 0.596                                        |
| Strontium carbonate (SrCO <sub>3</sub> )                  | 0.298                                        |

<sup>a</sup> Emission factors in units of metric tons of CO<sub>2</sub> emitted per metric ton of carbonate-based raw material charged to the furnace.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66462, Oct. 28, 2010]

## Subpart O—HCFC-22 Production and HFC-23 Destruction

### § 98.150 Definition of the source category.

The HCFC-22 production and HFC-23 destruction source category consists of HCFC-22 production processes and HFC-23 destruction processes.

- (a) An HCFC-22 production process produces HCFC-22 (chlorodifluoromethane, or CHClF<sub>2</sub>) from chloroform (CHCl<sub>3</sub>) and hydrogen fluoride (HF).
- (b) An HFC-23 destruction process is any process in which HFC-23 undergoes destruction. An HFC-23 destruction process may or may not be co-located with an HCFC-22 production process at the same facility.

### § 98.151 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an HCFC-22 production or HFC-23 destruction process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.152 GHGs to report.

- (a) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit following the requirements of subpart C.

- (b) You must report HFC-23 emissions from HCFC-22 production processes and HFC-23 destruction processes.

### § 98.153 Calculating GHG emissions.

- (a) The mass of HFC-23 generated from each HCFC-22 production process shall be estimated by using one of two methods, as applicable:
- (1) Where the mass flow of the combined stream of HFC-23 and another reaction product (e.g., HCl) is measured, multiply the weekly (or more frequent) HFC-23 concentration measurement (which may be the average of more frequent concentration measurements) by the weekly (or more frequent) mass flow of the combined stream of HFC-23 and the other product. To estimate annual HFC-23 production, sum the weekly (or more frequent) estimates of the quantities of HFC-23 produced over the year. This calculation is summarized in Equation O-1 of this section:

$$G_{23} = \sum_{p=1}^n c_{23} \cdot F_p \cdot 10^{-3} \quad (\text{Eq. O-1})$$

Where:

$G_{23}$  = Mass of HFC-23 generated annually (metric tons).

$c_{23}$  = Fraction HFC-23 by weight in HFC-23/other product stream.

$F_p$  = Mass flow of HFC-23/other product stream during the period  $p$  (kg).

$p$  = Period over which mass flows and concentrations are measured.

$n$  = Number of concentration and flow measurement periods for the year.

$10^{-3}$  = Conversion factor from kilograms to metric tons.

- (2) Where the mass of only a reaction product other than HFC-23 (either HCFC-22 or HCl) is measured, multiply the ratio of the weekly (or more frequent) measurement of the HFC-23 concentration and the weekly (or more frequent) measurement of the other product concentration by the weekly (or more frequent) mass produced of the other product. To estimate annual HFC-23 production, sum the weekly (or more frequent) estimates of the quantities of HFC-23 produced over the year. This calculation is summarized in Equation O-2 of this section, assuming that the other product is HCFC-22. If the other product is HCl, HCl may be substituted for HCFC-22 in Equations O-2 and O-3 of this section.

$$G_{23} = \sum_{p=1}^n \left( \frac{c_{23}}{c_{22}} \right) \cdot F_{22} \cdot 10^{-3} \quad (\text{Eq. O-2})$$

Where:

$G_{23}$  = Mass of HFC-23 generated annually (metric tons).

$C_{23}$  = Fraction HFC-23 by weight in HCFC-22/HFC-23 stream.

$C_{22}$  = Fraction HCFC-22 by weight in HCFC-22/HFC-23 stream.

$P_{22}$  = Mass of HCFC-22 produced over the period  $p$  (kg), calculated using Equation O-3 of this section.

$p$  = Period over which masses and concentrations are measured.

$n$  = Number of concentration and mass measurement periods for the year.

$10^{-3}$  = Conversion factor from kilograms to metric tons.

- (b) The mass of HCFC-22 produced over the period  $p$  shall be estimated by using Equation O-3 of this section:

$$P_{22} = LF * (O_{22} - U_{22}) \quad (\text{Eq. O-3})$$

Where:

$P_{22}$  = Mass of HCFC-22 produced over the period  $p$  (kg).

$O_{22}$  = mass of HCFC-22 that is measured coming out of the Production process over the period  $p$  (kg).

$U_{22}$  = Mass of used HCFC-22 that is added to the production process upstream of the output measurement over the period  $p$  (kg).

$LF$  = Factor to account for the loss of HCFC-22 upstream of the measurement. The value for  $LF$  shall be determined pursuant to § 98.154(e).

- (c) For HCFC-22 production facilities that do not use a destruction device or that have a destruction device that is not directly connected to the HCFC-22 production equipment, HFC-23 emissions shall be estimated using Equation O-4 of this section:

$$E_{23} = G_{23} - (S_{23} + OD_{23} + D_{23} + I_{23}) \quad (\text{Eq. O-4})$$

Where:

$E_{23}$  = Mass of HFC-23 emitted annually (metric tons).

$G_{23}$  = Mass of HFC-23 generated annually (metric tons).

$S_{23}$  = Mass of HFC-23 sent off site for sale annually (metric tons).

$OD_{23}$  = Mass of HFC-23 sent off site for destruction (metric tons).

$D_{23}$  = Mass of HFC-23 destroyed on site (metric tons).

$I_{23}$  = Increase in HFC-23 inventory = HFC-23 in storage at end of year—HFC-23 in storage at beginning of year (metric tons).

- (d) For HCFC-22 production facilities that use a destruction device connected to the HCFC-22 production equipment, HFC-23 emissions shall be estimated using Equation O-5 of this section:

$$E_{23} = E_L + E_{PV} + E_D \quad (\text{Eq. O-5})$$

Where:

$E_{23}$  = Mass of HFC-23 emitted annually (metric tons).

$E_L$  = Mass of HFC-23 emitted annually from equipment leaks, calculated using Equation O-6 of this section (metric tons).

$E_{PV}$  = Mass of HFC-23 emitted annually from process vents, calculated using Equation O-7 of this section (metric tons).

$E_D$  = Mass of HFC-23 emitted annually from destruction device (metric tons), calculated using Equation O-8 of this section.

- (1) The mass of HFC-23 emitted annually from equipment leaks (for use in Equation O-5 of this section) shall be estimated by using Equation O-6 of this section:

$$E_L = \sum_{p=1}^n \sum_t c_{23} \cdot (F_{Gt} \cdot N_{Gt} + F_{Lt} \cdot N_{Lt}) \cdot 10^{-3} \quad (\text{Eq. O-6})$$

Where:

$E_L$  = Mass of HFC-23 emitted annually from equipment leaks (metric tons).

$c_{23}$  = Fraction HFC-23 by weight in the stream(s) in the equipment.

$F_{Gt}$  = The applicable leak rate specified in Table O-1 of this subpart for each source of equipment type and service t with a screening value greater than or equal to 10,000 ppmv (kg/hr/source).

$N_{Gt}$  = The number of sources of equipment type and service t with screening values greater than or equal to 10,000 ppmv as determined according to § 98.154(i).

$F_{Lt}$  = The applicable leak rate specified in Table O-1 of this subpart for each source of equipment type and service t with a screening value of less than 10,000 ppmv (kg/hr/source).

$N_{Lt}$  = The number of sources of equipment type and service t with screening values less than 10,000 ppmv as determined according to § 98.154(j).

p = One hour.

$n$  = Number of hours during the year during which equipment contained HFC-23.

$t$  = Equipment type and service as specified in Table O-1 of this subpart.

$10^{-3}$  = Factor converting kg to metric tons.

- (2) The mass of HFC-23 emitted annually from process vents (for use in Equation O-5 of this section) shall be estimated by using Equation O-7 of this section:

$$E_{PV} = \sum_{p=1}^n ER_T \times \left( \frac{PR_p}{PR_T} \right) \times I_p \times 10^{-3} \quad (\text{Eq. O-7})$$

Where:

$E_{PV}$  = Mass of HFC-23 emitted annually from process vents (metric tons).

$ER_T$  = The HFC-23 emission rate from the process vents during the period of the most recent test (kg/hr).

$PR_p$  = The HCFC-22 production rate during the period  $p$  (kg/hr).

$PR_T$  = The HCFC-22 production rate during the most recent test period (kg/hr).

$I_p$  = The length of the period  $p$  (hours).

$10^{-3}$  = Factor converting kg to metric tons.

$n$  = The number of periods in a year.

- (3) The total mass of HFC-23 emitted from destruction devices shall be estimated by using Equation O-8 of this section:

$$E_D = F_D - D_{23} \quad (\text{Eq. O-8})$$

Where:

$E_D$  = Mass of HFC-23 emitted annually from the destruction device (metric tons).

$F_D$  = Mass of HFC-23 fed into the destruction device annually (metric tons).

$D_{23}$  = Mass of HFC-23 destroyed annually (metric tons).

- (4) For facilities that destroy HFC-23, the total mass of HFC-23 destroyed shall be estimated by using Equation O-9 of this section:

$$D_{23} = F_D \times DE \quad (\text{Eq. O-9})$$

Where:

$D_{23}$  = Mass of HFC-23 destroyed annually (metric tons).

$F_D$  = Mass of HFC-23 fed into the destruction device annually (metric tons).

DE = Destruction Efficiency of the destruction device (fraction).

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71955, Nov. 29, 2013]

## § 98.154 Monitoring and QA/QC requirements.

These requirements apply to measurements that are reported under this subpart or that are used to estimate reported quantities pursuant to § 98.153.

- (a) The concentrations (fractions by weight) of HFC-23 and HCFC-22 in the product stream shall be measured at least weekly using equipment and methods (e.g., gas chromatography) with an accuracy and precision of 5 percent or better at the concentrations of the process samples.
- (b) The mass flow of the product stream containing the HFC-23 shall be measured at least weekly using weigh scales, flowmeters, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better.
- (c) The mass of HCFC-22 or HCl coming out of the production process shall be measured at least weekly using weigh scales, flowmeters, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better.
- (d) The mass of any used HCFC-22 added back into the production process upstream of the output measurement in paragraph (c) of this section shall be measured (when being added) using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better. If the mass in paragraph (c) of this section is measured by weighing containers that include returned heels as well as newly produced fluorinated GHGs, the returned heels shall be considered used fluorinated HCFC-22 for purposes of this paragraph (d) of this section and § 98.153(b).
- (e) The loss factor LF in Equation O-3 of this subpart for the mass of HCFC-22 produced shall have the value 1.015 or another value that can be demonstrated, to the satisfaction of the Administrator, to account for losses of HCFC-22 between the reactor and the point of measurement at the facility where production is being estimated.
- (f) The mass of HFC-23 sent off site for sale shall be measured at least weekly (when being packaged) using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better.
- (g) The mass of HFC-23 sent off site for destruction shall be measured at least weekly (when being packaged) using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better. If the measured mass includes more than trace concentrations of materials other than HFC-23, the concentration of the fluorinated GHG shall be measured at least weekly using equipment and methods (e.g., gas chromatography) with an accuracy and precision of 5 percent or better at the concentrations of the process samples. This concentration (mass fraction) shall be multiplied by the mass measurement to obtain the mass of the HFC-23 sent to another facility for destruction.

- (h) The masses of HFC-23 in storage at the beginning and end of the year shall be measured using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better.
- (i) The number of sources of equipment type t with screening values greater than or equal to 10,000 ppmv shall be determined using EPA Method 21 at 40 CFR part 60, appendix A-7, and defining a leak as follows:
  - (1) A leak source that could emit HFC-23, and
  - (2) A leak source at whose surface a concentration of fluorocarbons equal to or greater than 10,000 ppm is measured.
- (j) The number of sources of equipment type t with screening values less than 10,000 ppmv shall be the difference between the number of leak sources of equipment type t that could emit HFC-23 and the number of sources of equipment type t with screening values greater than or equal to 10,000 ppmv as determined under paragraph (i) of this section.
- (k) The mass of HFC-23 emitted from process vents shall be estimated at least monthly by incorporating the results of the most recent emissions test into Equation O-7 of this subpart. HCFC-22 production facilities that use a destruction device connected to the HCFC-22 production equipment shall conduct emissions tests at process vents at least once every five years or after significant changes to the process. Emissions tests shall be conducted in accordance with EPA Method 18 at 40 CFR part 60, appendix A-6, under conditions that are typical for the production process at the facility. The sensitivity of the tests shall be sufficient to detect an emission rate that would result in annual emissions of 200 kg of HFC-23 if sustained over one year.
- (l) For purposes of Equation O-9 of this subpart, the destruction efficiency must be equated to the destruction efficiency determined during a new or previous performance test of the destruction device. HFC-23 destruction facilities shall conduct annual measurements of HFC-23 concentrations at the outlet of the destruction device in accordance with EPA Method 18 at 40 CFR part 60, appendix A-6. Three samples shall be taken under conditions that are typical for the production process and destruction device at the facility, and the average concentration of HFC-23 shall be determined. The sensitivity of the concentration measurement shall be sufficient to detect an outlet concentration equal to or less than the outlet concentration determined in the destruction efficiency performance test. If the concentration measurement indicates that the HFC-23 concentration is less than or equal to that measured during the performance test that is the basis for the destruction efficiency, continue to use the previously determined destruction efficiency. If the concentration measurement indicates that the HFC-23 concentration is greater than that measured during the performance test that is the basis for the destruction efficiency, facilities shall either:
  - (1) Substitute the higher HFC-23 concentration for that measured during the destruction efficiency performance test and calculate a new destruction efficiency, or
  - (2) Estimate the mass emissions of HFC-23 from the destruction device based on the measured HFC-23 concentration and volumetric flow rate determined by measurement of volumetric flow rate using EPA Method 2, 2A, 2C, 2D, or 2F at 40 CFR part 60, appendix A-1, or Method 26 at 40 CFR part 60, appendix A-2. Determine the mass rate of HFC-23 into the destruction device by measuring the HFC-23 concentration and volumetric flow rate at the inlet or by a metering device for HFC-23 sent to the device. Determine a new destruction efficiency based on the mass flow rate of HFC-23 into and out of the destruction device.

- (m) HCFC-22 production facilities shall account for HFC-23 generation and emissions that occur as a result of startups, shutdowns, and malfunctions, either recording HFC-23 generation and emissions during these events, or documenting that these events do not result in significant HFC-23 generation and/or emissions.
- (n) The mass of HFC-23 fed into the destruction device shall be measured at least weekly using flow meters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of 1.0 percent of full scale or better. If the measured mass includes more than trace concentrations of materials other than HFC-23, the concentrations of the HFC-23 shall be measured at least weekly using equipment and methods (e.g., gas chromatography) with an accuracy and precision of 5 percent or better at the concentrations of the process samples. This concentration (mass fraction) shall be multiplied by the mass measurement to obtain the mass of the HFC-23 destroyed.
- (o) In their estimates of the mass of HFC-23 destroyed, HFC-23 destruction facilities shall account for any temporary reductions in the destruction efficiency that result from any startups, shutdowns, or malfunctions of the destruction device, including departures from the operating conditions defined in State or local permitting requirements and/or destruction device manufacturer specifications.
- (p) Calibrate all flow meters, weigh scales, and combinations of volumetric and density measures using NIST-traceable standards and suitable methods published by a consensus standards organization (e.g., ASTM, ASME, ISO, or others). Recalibrate all flow meters, weigh scales, and combinations of volumetric and density measures at the minimum frequency specified by the manufacturer.
- (q) All gas chromatographs used to determine the concentration of HFC-23 in process streams shall be calibrated at least monthly through analysis of certified standards (or of calibration gases prepared from a high-concentration certified standard using a gas dilution system that meets the requirements specified in Method 205 at 40 CFR part 51, appendix M) with known HFC-23 concentrations that are in the same range (fractions by mass) as the process samples.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66462, Oct. 28, 2010; 78 FR 71955, Nov. 29, 2013]

## § 98.155 Procedures for estimating missing data.

- (a) A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required process sample is not taken), a substitute data value for the missing parameter shall be used in the calculations, according to the following requirements:
  - (1) For each missing value of the HFC-23 or HCFC-22 concentration, the substitute data value shall be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.
  - (2) For each missing value of the product stream mass flow or product mass, the substitute value of that parameter shall be a secondary product measurement where such a measurement is available. If that measurement is taken significantly downstream of the usual mass flow or mass measurement (e.g., at the shipping dock rather than near the reactor), the measurement shall be multiplied by 1.015 to compensate for losses. Where a secondary mass measurement is not available, the substitute value of the parameter shall be an estimate based on a related parameter. For example, if a flowmeter measuring the mass fed into a destruction device is rendered inoperable,



then the mass fed into the destruction device may be estimated using the production rate and the previously observed relationship between the production rate and the mass flow rate into the destruction device.

### § 98.156 Data reporting requirements.

- (a) In addition to the information required by § 98.3(c), the HCFC-22 production facility shall report the following information for each HCFC-22 production process:
  - (1) Annual mass of HCFC-22 produced in metric tons.
  - (2) [Reserved]
  - (3) Annual mass of reactants fed into the process in metric tons of reactant.
  - (4) The mass (in metric tons) of materials other than HCFC-22 and HFC-23 (i.e., unreacted reactants, HCl and other by-products) that occur in more than trace concentrations and that are permanently removed from the process.
  - (5) The method for tracking startups, shutdowns, and malfunctions and HFC-23 generation/emissions during these events.
  - (6) The names and addresses of facilities to which any HFC-23 was sent for destruction, and the quantities of HFC-23 (metric tons) sent to each.
  - (7)-(10) [Reserved]
  - (11) Annual mass of HFC-23 emitted in metric tons.
  - (12) Annual mass of HFC-23 emitted from equipment leaks in metric tons.
  - (13) Annual mass of HFC-23 emitted from process vents in metric tons.
- (b) In addition to the information required by § 98.3(c), facilities that destroy HFC-23 shall report the following for each HFC-23 destruction process:
  - (1)-(2) [Reserved]
  - (3) Annual mass of HFC-23 emitted from the destruction device.
- (c) Each HFC-23 destruction facility shall report the concentration (mass fraction) of HFC-23 measured at the outlet of the destruction device during the facility's annual HFC-23 concentration measurements at the outlet of the device. If the concentration of HFC-23 is below the detection limit of the measuring device, report the detection limit and that the concentration is below the detection limit.
- (d) If the HFC-23 concentration measured pursuant to § 98.154(l) is greater than that measured during the performance test that is the basis for the destruction efficiency (DE), the facility shall report the method used to calculate the revised destruction efficiency, specifying whether § 98.154(l)(1) or (2) has been used for the calculation.
- (e) By March 31, 2011 or within 60 days of commencing HFC-23 destruction, HFC-23 destruction facilities shall submit a one-time report including the following information for each destruction process:
  - (1) [Reserved]
  - (2) The methods used to determine destruction efficiency.
  - (3) The methods used to record the mass of HFC-23 destroyed.

- (4) The name of other relevant federal or state regulations that may apply to the destruction process.
- (5) If any changes are made that affect HFC-23 destruction efficiency or the methods used to record volume destroyed, then these changes must be reflected in a revision to this report. The revised report must be submitted to EPA within 60 days of the change.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66463, Oct. 28, 2010; 78 FR 71955, Nov. 29, 2013; 79 FR 63786, Oct. 24, 2014; 81 FR 89257, Dec. 9, 2016]

### § 98.157 Records that must be retained.

- (a) In addition to the data required by § 98.3(g), HCFC-22 production facilities shall retain the following records:
  - (1) The data used to estimate HFC-23 emissions.
  - (2) Records documenting the initial and periodic calibration of the gas chromatographs, weigh scales, volumetric and density measurements, and flowmeters used to measure the quantities reported under this rule, including the industry standards or manufacturer directions used for calibration pursuant to § 98.154(p) and (q).
- (b) In addition to the data required by § 98.3(g), the HFC-23 destruction facilities shall retain the following records:
  - (1) Records documenting their one-time and annual reports in § 98.156(b) through (e).
  - (2) Records documenting the initial and periodic calibration of the gas chromatographs, weigh scales, volumetric and density measurements, and flowmeters used to measure the quantities reported under this subpart, including the industry standard practice or manufacturer directions used for calibration pursuant to § 98.154(p) and (q).
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) through (16) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) through (16) of this section.
  - (1) Factor to account for the loss of HCFC-22 upstream of the measurement over the period, determined pursuant to § 98.154(e) (Equation O-3 of § 98.153).
  - (2) Mass of HCFC-22 that is measured coming out of the production process over the period. A period can be one year (kg) (Equation O-3).
  - (3) Mass of used HCFC-22 that is added to the production process upstream of the output measurement over the period. A period can be one year (kg) (Equation O-3).
  - (4) Mass of HFC-23 generated annually per HCFC-22 production process (metric tons) (Equation O-4 of § 98.153).
  - (5) Mass of HFC-23 sent off site for sale annually per HCFC-22 production process (metric tons) (Equation O-4).
  - (6) Mass of HFC-23 sent off site for destruction annually per HCFC-22 production process (metric tons) (Equation O-4).
  - (7) Mass of HFC-23 destroyed on site per HCFC-22 production process (metric tons) (Equation O-4).

- (8) HFC-23 in storage at end of year per HCFC-22 production process (metric tons) (Equation O-4).
- (9) HFC-23 in storage at beginning of year per HCFC-22 production process (metric tons) (Equation O-4).
- (10) Mass of HFC-23 fed into each destruction device annually per HCFC-22 production process (metric tons) (Equation O-9 of § 98.153 and the calculation method in either § 98.154(l)(1) or (2)).
- (11) Identify if each destruction efficiency for each HCFC-22 production process is entered directly, or is calculated using § 98.154(l)(1), or is calculated using § 98.154(l)(2) (Equation O-9 and the calculation method in either § 98.154(l)(1) or (2)).
- (12) Destruction efficiency of each destruction device for each HCFC-22 production process (decimal fraction) (Equation O-9 and the calculation method in either § 98.154(l)(1) or (2)).
- (13) Volumetric flow rate at the inlet of each destruction device for each HCFC-22 production process from previous test (kg/hr) (Equation O-9 and the calculation method in either § 98.154(l)(1) or (2)).
- (14) Volumetric flow rate at the inlet of destruction device during test for each HCFC-22 production process (kg/hr) (Equation O-9 and the calculation method in either § 98.154(l)(1) or (2)).
- (15) Concentration of HFC-23 at the inlet of destruction device for each HCFC-22 production process from previous test (weight fraction) (Equation O-9 and the calculation method in either § 98.154(l)(1) or (2)).
- (16) Concentration of HFC-23 at the inlet of destruction device for each HCFC-22 production process during test (weight fraction) (Equation O-9 and the calculation method in either § 98.154(l)(1) or (2)).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66463, Oct. 28, 2010; 79 FR 63786, Oct. 24, 2014]

## § 98.158 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Table O-1 to Subpart O of Part 98—Emission Factors for Equipment Leaks**

| Equipment type         | Service      | Emission factor<br>(kg/hr/source) |              |
|------------------------|--------------|-----------------------------------|--------------|
|                        |              | ≥10,000 ppmv                      | <10,000 ppmv |
| Valves                 | Gas          | 0.0782                            | 0.000131     |
| Valves                 | Light liquid | 0.0892                            | 0.000165     |
| Pump seals             | Light liquid | 0.243                             | 0.00187      |
| Compressor seals       | Gas          | 1.608                             | 0.0894       |
| Pressure relief valves | Gas          | 1.691                             | 0.0447       |
| Connectors             | All          | 0.113                             | 0.0000810    |
| Open-ended lines       | All          | 0.01195                           | 0.00150      |

## Subpart P—Hydrogen Production

## § 98.160 Definition of the source category.

- (a) A hydrogen production source category consists of facilities that produce hydrogen gas as a product.
- (b) This source category comprises process units that produce hydrogen by reforming, gasification, oxidation, reaction, or other transformations of feedstocks except the processes listed in paragraph (b)(1) or (2) of this section.
  - (1) Any process unit for which emissions are reported under another subpart of this part. This includes, but is not necessarily limited to:
    - (i) Ammonia production units for which emissions are reported under subpart G.
    - (ii) Catalytic reforming units at petroleum refineries that transform naphtha into higher octane aromatics for which emissions are reported under subpart Y.
    - (iii) Petrochemical process units for which emissions are reported under subpart X.
  - (2) Any process unit that only separates out diatomic hydrogen from a gaseous mixture and is not associated with a unit that produces hydrogen created by transformation of one or more feedstocks, other than those listed in paragraph (b)(1) of this section.
- (c) This source category includes the process units that produce hydrogen and stationary combustion units directly associated with hydrogen production (e.g., reforming furnace and hydrogen production process unit heater).

[89 FR 31925, Apr. 25, 2024]

## § 98.161 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a hydrogen production process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

## § 98.162 GHGs to report.

You must report:

- (a) CO<sub>2</sub> emissions from each hydrogen production process unit, including fuel combustion emissions accounted for in the calculation methodologies in § 98.163.
- (b) [Reserved]
- (c) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit other than hydrogen production process units. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (d) For CO<sub>2</sub> collected and transferred off site, you must follow the requirements of subpart PP of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66463, Oct. 28, 2010; 89 FR 31926, Apr. 25, 2024]

## § 98.163 Calculating GHG emissions.

You must calculate and report the annual CO<sub>2</sub> emissions from each hydrogen production process unit using the procedures specified in paragraphs (a) through (c) of this section, as applicable.

- (a) **Continuous Emissions Monitoring Systems (CEMS).** Calculate and report under this subpart the CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) **Fuel and feedstock material balance approach.** Calculate and report CO<sub>2</sub> emissions as the sum of the annual emissions associated with each fuel and feedstock used for each hydrogen production process unit by following paragraphs (b)(1) through (3) of this section. The carbon content and molecular weight shall be obtained from the analyses conducted in accordance with § 98.164(b)(2), (3), or (4), as applicable, or from the missing data procedures in § 98.165. If the analyses are performed annually, then the annual value shall be used as the monthly average. If the analyses are performed more frequently than monthly, use the arithmetic average of values obtained during the month as the monthly average.
- (1) **Gaseous fuel and feedstock.** You must calculate the annual CO<sub>2</sub> emissions from each gaseous fuel and feedstock according to Equation P-1 of this section:

$$CO_2 = \left( \sum_{n=1}^k \frac{44}{12} \cdot F_{dst} / k_n \cdot CC_n \cdot \frac{MW}{MVC} \right) \cdot 0.001 \quad (\text{Eq. P-1})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> process emissions arising from fuel and feedstock consumption (metric tons/yr).

Fdstk<sub>n</sub> = Volume or mass of the gaseous fuel or feedstock used in month n (scf (at standard conditions of 68 °F and atmospheric pressure) or kg of fuel or feedstock).

CC<sub>n</sub> = Average carbon content of the gaseous fuel or feedstock for month n (kg carbon per kg of fuel or feedstock).

MW<sub>n</sub> = Average molecular weight of the gaseous fuel or feedstock for month n (kg/kg-mole). If you measure mass, the term "MW<sub>n</sub>/MVC" is replaced with "1".

MVC = Molar volume conversion factor (849.5 scf per kg-mole at standard conditions).

k = Months in the year.

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon. 0.001 = Conversion factor from kg to metric tons.

- (2) **Liquid fuel and feedstock.** You must calculate the annual CO<sub>2</sub> emissions from each liquid fuel and feedstock according to Equation P-2 of this section:

$$CO_2 = \left( \sum_{n=1}^k \frac{44}{12} \cdot F_{dst} / k_n \cdot CC_n \right) \cdot 0.001 \quad (\text{Eq. P-2})$$

Where:

$CO_2$  = Annual  $CO_2$  emissions arising from fuel and feedstock consumption (metric tons/yr).

$Fdstk_n$  = Volume or mass of the liquid fuel or feedstock used in month  $n$  (gallons or kg of fuel or feedstock).

$CC_n$  = Average carbon content of the liquid fuel or feedstock, for month  $n$  (kg carbon per gallon or kg of fuel or feedstock).

$k$  = Months in the year.

$44/12$  = Ratio of molecular weights,  $CO_2$  to carbon.

$0.001$  = Conversion factor from kg to metric tons.

- (3) **Solid fuel and feedstock.** You must calculate the annual  $CO_2$  emissions from each solid fuel and feedstock according to Equation P-3 of this section:

$$CO_2 = \left( \sum_{n=1}^k \frac{44}{12} \cdot Fdstk_n \cdot CC_n \right) \cdot 0.001 \quad (\text{Eq. P-3})$$

Where:

$CO_2$  = Annual  $CO_2$  emissions from fuel and feedstock consumption (metric tons/yr).

$Fdstk_n$  = Mass of solid fuel or feedstock used in month  $n$  (kg of fuel or feedstock).

$CC_n$  = Average carbon content of the solid fuel or feedstock, for month  $n$  (kg carbon per kg of fuel or feedstock).

$k$  = Months in the year.

$44/12$  = Ratio of molecular weights,  $CO_2$  to carbon.

$0.001$  = Conversion factor from kg to metric tons.

- (c) If GHG emissions from a hydrogen production process unit are vented through the same stack as any combustion unit or process equipment that reports  $CO_2$  emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part, then the owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part. If GHG emissions from a hydrogen production process unit using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part does not include combustion emissions from the hydrogen production unit (*i.e.*, the hydrogen production unit has separate stacks for process and combustion emissions), then the calculation methodology in paragraph (b) of this section shall be used considering only fuel inputs to calculate and report  $CO_2$  emissions from fuel combustion related to the hydrogen production unit.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66463, Oct. 28, 2010; 75 FR 79157, Dec. 17, 2010; 78 FR 71955, Nov. 29, 2013; 81 FR 89257, Dec. 9, 2016; 89 FR 31926, Apr. 25, 2024]

## § 98.164 Monitoring and QA/QC requirements.

The GHG emissions data for hydrogen production process units must be quality-assured as specified in paragraph (a) or (b) of this section, as appropriate for each process unit, except as provided in paragraph (c) of this section:

- (a) If a CEMS is used to measure GHG emissions, then the facility must comply with the monitoring and QA/QC procedures specified in § 98.34(c).
- (b) If a CEMS is not used to measure GHG emissions, then you must:
  - (1) Calibrate all oil and gas flow meters that are used to measure liquid and gaseous fuel and feedstock volumes (except for gas billing meters) according to the monitoring and QA/QC requirements for the Tier 3 methodology in § 98.34(b)(1). Perform oil tank drop measurements (if used to quantify liquid fuel or feedstock consumption) according to § 98.34(b)(2). Calibrate all solids weighing equipment according to the procedures in § 98.3(i).
  - (2) Determine the carbon content and the molecular weight annually of standard gaseous hydrocarbon fuels and feedstocks having consistent composition (e.g., natural gas) according to paragraph (b)(5) of this section. For gaseous fuels and feedstocks that have a maximum product specification for carbon content less than or equal to 0.00002 kg carbon per kg of gaseous fuel or feedstock, you may instead determine the carbon content and the molecular weight annually using the product specification's maximum carbon content and molecular weight. For other gaseous fuels and feedstocks (e.g., biogas, refinery gas, or process gas), sample and analyze no less frequently than weekly to determine the carbon content and molecular weight of the fuel and feedstock according to paragraph (b)(5) of this section.
  - (3) Determine the carbon content of fuel oil, naphtha, and other liquid fuels and feedstocks at least monthly, except annually for standard liquid hydrocarbon fuels and feedstocks having consistent composition, or upon delivery for liquid fuels and feedstocks delivered by bulk transport (e.g., by truck or rail) according to paragraph (b)(5) of this section. For liquid fuels and feedstocks that have a maximum product specification for carbon content less than or equal to 0.00006 kg carbon per gallon of liquid fuel or feedstock, you may instead determine the carbon content annually using the product specification's maximum carbon content.
  - (4) Determine the carbon content of coal, coke, and other solid fuels and feedstocks at least monthly, except annually for standard solid hydrocarbon fuels and feedstocks having consistent composition, or upon delivery for solid fuels and feedstocks delivered by bulk transport (e.g., by truck or rail) according to paragraph (b)(5) of this section.
  - (5) Except as provided in paragraphs (b)(2) and (3) of this section for fuels and feedstocks with a carbon content below the specified levels, you must use the following applicable methods to determine the carbon content for all fuels and feedstocks, and molecular weight of gaseous fuels and feedstocks. Alternatively, you may use the results of chromatographic analysis of the fuel and feedstock, provided that the chromatograph is operated, maintained, and calibrated according to the manufacturer's instructions; and the methods used for operation, maintenance, and calibration of the chromatograph are documented in the written monitoring plan for the unit under § 98.3(g)(5).

- (i) ASTM D1945-03 Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, see § 98.7).
- (ii) ASTM D1946-90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference, see § 98.7).
- (iii) ASTM D2013-07 Standard Practice of Preparing Coal Samples for Analysis (incorporated by reference, see § 98.7).
- (iv) ASTM D2234/D2234M-07 Standard Practice for Collection of a Gross Sample of Coal (incorporated by reference, see § 98.7).
- (v) ASTM D2597-94 (Reapproved 2004) Standard Test Method for Analysis of Demethanized Hydrocarbon Liquid Mixtures Containing Nitrogen and Carbon Dioxide by Gas Chromatography (incorporated by reference, see § 98.7).
- (vi) ASTM D3176-89 (Reapproved 2002), Standard Practice for Ultimate Analysis of Coal and Coke (incorporated by reference, see § 98.7).
- (vii) ASTM D3238-95 (Reapproved 2005), Standard Test Method for Calculation of Carbon Distribution and Structural Group Analysis of Petroleum Oils by the n-d-M Method (incorporated by reference, see § 98.7).
- (viii) ASTM D4057-06 Standard Practice for Manual Sampling of Petroleum and Petroleum Products (incorporated by reference, see § 98.7).
- (ix) ASTM D4177-95 (Reapproved 2005) Standard Practice for Automatic Sampling of Petroleum and Petroleum Products (incorporated by reference, see § 98.7).
- (x) ASTM D5291-02 (Reapproved 2007), Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants (incorporated by reference, see § 98.7).
- (xi) ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7).
- (xii) ASTM D6609-08 Standard Guide for Part-Stream Sampling of Coal (incorporated by reference, see § 98.7).
- (xiii) ASTM D6883-04 Standard Practice for Manual Sampling of Stationary Coal from Railroad Cars, Barges, Trucks, or Stockpiles (incorporated by reference, see § 98.7).
- (xiv) ASTM D7430-08ae1 Standard Practice for Mechanical Sampling of Coal (incorporated by reference, see § 98.7).
- (xv) ASTM UOP539-97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).
- (xvi) GPA 2261-00 Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography (incorporated by reference, see § 98.7).
- (xvii) ISO 3170: Petroleum Liquids—Manual sampling—Third Edition (incorporated by reference, see § 98.7).
- (xviii) ISO 3171: Petroleum Liquids—Automatic pipeline sampling—Second Edition (incorporated by reference, see § 98.7).



(xix) For fuels and feedstocks with a carbon content below the specified levels in paragraphs (b)(2) and (3) of this section, if the methods listed in paragraphs (b)(5)(i) through (xviii) of this section are not appropriate because the relevant compounds cannot be detected, the quality control requirements are not technically feasible, or use of the method would be unsafe, you may use modifications of the methods listed in paragraphs (b)(5)(i) through (xviii) or use other methods that are applicable to your fuel or feedstock.

(c) You may use best available monitoring methods as specified in paragraph (c)(2) of this section for measuring the fuel used by each stationary combustion unit directly associated with hydrogen production (e.g., reforming furnace and hydrogen production process unit heater) that meets the criteria specified in paragraph (c)(1) of this section. Eligibility to use best available monitoring methods ends upon the completion of any planned process unit or equipment shutdown after January 1, 2025.

(1) To be eligible to use best available monitoring methods, you must meet all criteria in paragraphs (c)(1)(i) through (iv) of this section.

(i) The stationary combustion unit must be directly associated with hydrogen production (e.g., reforming furnace and hydrogen production process unit heater).

(ii) A measurement device meeting the requirements in paragraph (b)(1) of this section is not installed to measure the fuel used by each stationary combustion unit as of January 1, 2025.

(iii) The hydrogen production unit and associated stationary combustion unit are operated continuously.

(iv) Installation of a measurement device to measure the fuel used by each stationary combustion unit that meets the requirements in paragraph (b)(1) of this section must require a planned process equipment or unit shutdown or can only be done through a hot tap.

(2) Best available monitoring methods means any of the following methods:

(i) Monitoring methods currently used by the facility that do not meet the specifications of this subpart.

(ii) Supplier data.

(iii) Engineering calculations.

(iv) Other company records.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79157, Dec. 17, 2010; 78 FR 71955, Nov. 29, 2013; 81 FR 89257, Dec. 9, 2016; 89 FR 31926, Apr. 25, 2024]

## § 98.165 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation), a substitute data value for the missing parameter must be used in the calculations as specified in paragraphs (a), (b), and (c) of this section:

- (a) For each missing value of the monthly fuel and feedstock consumption, the substitute data value must be the best available estimate of the fuel and feedstock consumption, based on all available process data (e.g., hydrogen production, electrical load, and operating hours). You must document and keep records of the procedures used for all such estimates.
- (b) For each missing value of the carbon content or molecular weight of the fuel and feedstock, the substitute data value must be the arithmetic average of the quality-assured values of carbon contents or molecular weight of the fuel and feedstock immediately preceding and immediately following the missing data incident. If no quality-assured data on carbon contents or molecular weight of the fuel and feedstock are available prior to the missing data incident, the substitute data value must be the first quality-assured value for carbon contents or molecular weight of the fuel and feedstock obtained after the missing data period. You must document and keep records of the procedures used for all such estimates.
- (c) For missing CEMS data, you must use the missing data procedures in § 98.35.

### § 98.166 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information for each hydrogen production process unit:

- (a) The unit identification number.
- (b) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report the relevant information required under § 98.36 for the Tier 4 Calculation Methodology. If the CEMS measures emissions from either a common stack for multiple hydrogen production units or a common stack for hydrogen production unit(s) and other source(s), you must also report the estimated decimal fraction of the total annual CO<sub>2</sub> emissions attributable to this hydrogen production process unit (estimated using engineering estimates or best available data).
- (c) If a material balance is used to calculate emissions using equations P-1 through P-3 to § 98.163, as applicable, report the total annual CO<sub>2</sub> emissions (metric tons) and the name and annual quantity (metric tons) of each carbon-containing fuel and feedstock.
- (d) The information specified in paragraphs (d)(1) through (10):
  - (1) The type of hydrogen production unit (steam methane reformer (SMR) only, SMR followed by water gas shift reaction (WGS), partial oxidation (POX) only, POX followed by WGS, autothermal reforming only, autothermal reforming followed by WGS, water electrolysis, brine electrolysis, other (specify)).
  - (2) The type of hydrogen purification method (pressure swing adsorption, amine adsorption, membrane separation, other (specify), none).
  - (3) Annual quantity of hydrogen produced by reforming, gasification, oxidation, reaction, or other transformation of feedstocks (metric tons).
  - (4) Annual quantity of hydrogen that is purified only (metric tons). This quantity may be assumed to be equal to the annual quantity of hydrogen in the feedstocks to the hydrogen production unit.
  - (5) Annual quantity of ammonia intentionally produced as a desired product, if applicable (metric tons).
  - (6) Quantity of CO<sub>2</sub> collected and transferred off site in either gas, liquid, or solid forms, following the requirements of subpart PP of this part.

- (7) Annual quantity of carbon other than CO<sub>2</sub> or methanol collected and transferred off site or transferred to a separate process unit within the facility for which GHG emissions associated with this carbon is being reported under other provisions of this part, in either gas, liquid, or solid forms (metric tons carbon).
- (8) Annual quantity of methanol intentionally produced as a desired product, if applicable, (metric tons) for each process unit.
- (9) Annual net quantity of steam consumed by the unit, (metric tons). Include steam purchased or produced outside of the hydrogen production unit. If the hydrogen production unit is a net producer of steam, enter the annual net quantity of steam consumed by the unit as a negative value.
- (10) An indication (yes or no) if best available monitoring methods were used, in accordance with § 98.164(c), to determine fuel flow for each stationary combustion unit directly associated with hydrogen production (e.g., reforming furnace and hydrogen production process unit heater). If yes, report:
  - (i) The beginning date of using best available monitoring methods, in accordance with § 98.164(c), to determine fuel flow for each stationary combustion unit directly associated with hydrogen production (e.g., reforming furnace and hydrogen production process unit heater).
  - (ii) The anticipated or actual end date of using best available monitoring methods, as applicable, in accordance with § 98.164(c), to determine fuel flow for each stationary combustion unit directly associated with hydrogen production (e.g., reforming furnace and hydrogen production process unit heater).

[89 FR 31927, Apr. 25, 2024]

### § 98.167 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the records specified in paragraphs (a) through (e) of this section for each hydrogen production facility.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37, and, if the CEMS measures emissions from a common stack for multiple hydrogen production units or emissions from a common stack for hydrogen production unit(s) and other source(s), records used to estimate the decimal fraction of the total annual CO<sub>2</sub> emissions from the CEMS monitoring location attributable to each hydrogen production unit.
- (b) You must retain records of all analyses and calculations conducted to determine the values reported in § 98.166(b).
- (c) [Reserved]
- (d) The owner or operator must document the procedures used to ensure the accuracy of the estimates of fuel and feedstock usage in § 98.163(b), including, but not limited to, calibration of weighing equipment, fuel and feedstock flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.

- (e) The applicable verification software records as identified in this paragraph (e). You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (e)(1) through (12) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (e)(1) through (12) of this section for each hydrogen production unit.
- (1) Indicate whether the monthly consumption of each gaseous fuel or feedstock is measured as mass or volume (Equation P-1 of § 98.163).
  - (2) Monthly volume of the gaseous fuel or feedstock (scf at standard conditions of 68 °F and atmospheric pressure) (Equation P-1).
  - (3) Monthly mass of the gaseous fuel or feedstock (kg of fuel or feedstock) (Equation P-1).
  - (4) Average monthly carbon content of the gaseous fuel or feedstock (kg C per kg of fuel or feedstock) (Equation P-1).
  - (5) Average monthly molecular weight of the gaseous fuel or feedstock (kg/kg-mole) (Equation P-1).
  - (6) Indicate whether the monthly consumption of each liquid fuel or feedstock is measured as mass or volume (Equation P-2 of § 98.163).
  - (7) Monthly volume of the liquid fuel or feedstock (gallons of fuel or feedstock) (Equation P-2).
  - (8) Monthly mass of the liquid fuel or feedstock (kg of fuel or feedstock) (Equation P-2).
  - (9) Average monthly carbon content of the liquid fuel or feedstock (kg C per gallon of fuel or feedstock) (Equation P-2).
  - (10) Average monthly carbon content of the liquid fuel or feedstock (kg C per kg of fuel or feedstock) (Equation P-2).
  - (11) Monthly mass of solid fuel or feedstock (kg of fuel and feedstock) (Equation P-3 of § 98.163).
  - (12) Average monthly carbon content of the solid fuel or feedstock (kg C per kg of fuel and feedstock) (Equation P-3).

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71956, Nov. 29, 2013; 79 FR 63787, Oct. 24, 2014; 89 FR 31927, Apr. 25, 2024]

## § 98.168 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart Q—Iron and Steel Production

### § 98.170 Definition of the source category.

The iron and steel production source category includes facilities with any of the following processes: taconite iron ore processing, integrated iron and steel manufacturing, cokemaking not collocated with an integrated iron and steel manufacturing process, direct reduction furnaces not collocated with an integrated iron and steel manufacturing process, and electric arc furnace (EAF) steelmaking not collocated with an integrated iron and steel manufacturing process. Integrated iron and steel manufacturing means the production of steel from iron ore or iron

ore pellets. At a minimum, an integrated iron and steel manufacturing process has a basic oxygen furnace for refining molten iron into steel. Each cokemaking process and EAF process located at a facility with an integrated iron and steel manufacturing process is part of the integrated iron and steel manufacturing facility.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71955, Nov. 29, 2013]

### § 98.171 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an iron and steel production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.172 GHGs to report.

- (a) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit following the requirements of subpart C except for flares. Stationary combustion units include, but are not limited to, by-product recovery coke oven battery combustion stacks, blast furnace stoves, boilers, process heaters, reheat furnaces, annealing furnaces, flame suppression, ladle reheaters, and other miscellaneous combustion sources.
- (b) You must report CO<sub>2</sub> emissions from flares that burn blast furnace gas or coke oven gas according to the procedures in § 98.253(b)(1) of subpart Y (Petroleum Refineries) of this part. When using the alternatives set forth in § 98.253(b)(1)(ii)(B) and § 98.253(b)(1)(iii)(C), you must use the default CO<sub>2</sub> emission factors for coke oven gas and blast furnace gas from Table C-1 to subpart C in Equations Y-2 and Y-3 of subpart Y. You must report CH<sub>4</sub> and N<sub>2</sub>O emissions from flares according to the requirements in § 98.33(c)(2) using the emission factors for coke oven gas and blast furnace gas in Table C-2 to subpart C of this part.
- (c) You must report process CO<sub>2</sub> emissions from each taconite indurating furnace; basic oxygen furnace; non-recovery coke oven battery combustion stack; coke pushing process; sinter process; EAF; decarburization vessel; and direct reduction furnace by following the procedures in this subpart.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66463, Oct. 28, 2010]

### § 98.173 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each taconite indurating furnace, basic oxygen furnace, non-recovery coke oven battery, sinter process, EAF, decarburization vessel, and direct reduction furnace using the procedures in either paragraph (a) or (b) of this section. Calculate and report the annual process CO<sub>2</sub> emissions from the coke pushing process according to paragraph (c) of this section.

- (a) Calculate and report under this subpart the process CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart the process CO<sub>2</sub> emissions using the procedure in paragraph (b)(1) or (b)(2) of this section.
  - (1) **Carbon mass balance method.** Calculate the annual mass emissions of CO<sub>2</sub> for the process as specified in paragraphs (b)(1)(i) through (b)(1)(vii) of this section. The calculations are based on the annual mass of inputs and outputs to the process and an annual analysis of the respective weight fraction of carbon as determined according to the procedures in § 98.174(b). If you have a process

input or output other than CO<sub>2</sub> in the exhaust gas that contains carbon that is not included in Equations Q-1 through Q-7 of this section, you must account for the carbon and mass rate of that process input or output in your calculations according to the procedures in § 98.174(b)(5).

(i) For taconite indurating furnaces, estimate CO<sub>2</sub> emissions using Equation Q-1 of this section.

$$CO_2 = \frac{44}{12} \times \left[ (F_s) \times (C_{sf}) + (F_g) \times (C_{gf}) \times \frac{MW}{MVC} \times 0.001 + (F_l) \times (C_{lf}) \times 0.001 + (O) \times (C_o) - (P) \times (C_p) - (R) \times (C_R) \right] \quad (\text{Eq. Q-1})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from the taconite indurating furnace (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

(F<sub>s</sub>) = Annual mass of the solid fuel used (metric tons).

(C<sub>sf</sub>) = Carbon content of the solid fuel, from the fuel analysis (expressed as a decimal fraction).

(F<sub>g</sub>) = Annual volume of the gaseous fuel used (scf).

(C<sub>gf</sub>) = Average carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel).

MW = Molecular weight of the gaseous fuel (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf per kg-mole at standard conditions).

0.001 = Conversion factor from kg to metric tons.

(F<sub>l</sub>) = Annual volume of the liquid fuel used (gallons).

(C<sub>lf</sub>) = Carbon content of the liquid fuel, from the fuel analysis results (kg C per gallon of fuel).

(O) = Annual mass of greenball (taconite) pellets fed to the furnace (metric tons).

(C<sub>o</sub>) = Carbon content of the greenball (taconite) pellets, from the carbon analysis results (expressed as a decimal fraction).

(P) = Annual mass of fired pellets produced by the furnace (metric tons).

(C<sub>p</sub>) = Carbon content of the fired pellets, from the carbon analysis results (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

(C<sub>R</sub>) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction).

(ii) For basic oxygen process furnaces, estimate CO<sub>2</sub> emissions using Equation Q-2 of this section.

$$CO_2 = \frac{44}{12} * \left[ (Iron) * (C_{Iron}) + (Scrap) * (C_{Scrap}) + (Flux) * (C_{Flux}) + (Carbon) * (C_{Carbon}) - (Steel) * (C_{Steel}) - (Slag) * (C_{Slag}) - (R) * (C_R) \right] \quad (Eq. Q-2)$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions from the basic oxygen furnace (metric tons).

44/12 = Ratio of molecular weights,  $CO_2$  to carbon.

(Iron) = Annual mass of molten iron charged to the furnace (metric tons).

( $C_{Iron}$ ) = Carbon content of the molten iron, from the carbon analysis results (expressed as a decimal fraction).

(Scrap) = Annual mass of ferrous scrap charged to the furnace (metric tons).

( $C_{Scrap}$ ) = Carbon content of the ferrous scrap, from the carbon analysis results (expressed as a decimal fraction).

(Flux) = Annual mass of flux materials (e.g., limestone, dolomite) charged to the furnace (metric tons).

( $C_{Flux}$ ) = Carbon content of the flux materials, from the carbon analysis results (expressed as a decimal fraction).

(Carbon) = Annual mass of carbonaceous materials (e.g., coal, coke) charged to the furnace (metric tons).

( $C_{Carbon}$ ) = Carbon content of the carbonaceous materials, from the carbon analysis results (expressed as a decimal fraction).

(Steel) = Annual mass of molten raw steel produced by the furnace (metric tons).

( $C_{Steel}$ ) = Carbon content of the steel, from the carbon analysis results (expressed as a decimal fraction).

(Slag) = Annual mass of slag produced by the furnace (metric tons).

( $C_{Slag}$ ) = Carbon content of the slag, from the carbon analysis (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

( $C_R$ ) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction),

- (iii) For non-recovery coke oven batteries, estimate  $CO_2$  emissions using Equation Q-3 of this section.

$$CO_2 = \frac{44}{12} \cdot [(Coal) \cdot (C_{Coal}) - (Coke) \cdot (C_{Coke}) - (R) \cdot (C_R)] \quad (\text{Eq. Q-3})$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions from the non-recovery coke oven battery (metric tons).

44/12 = Ratio of molecular weights,  $CO_2$  to carbon.

(Coal) = Annual mass of coal charged to the battery (metric tons).

( $C_{Coal}$ ) = Carbon content of the coal, from the carbon analysis results (expressed as a decimal fraction).

(Coke) = Annual mass of coke produced by the battery (metric tons).

( $C_{Coke}$ ) = Carbon content of the coke, from the carbon analysis results (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

( $C_R$ ) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction).

(iv) For sinter processes, estimate  $CO_2$  emissions using Equation Q-4 of this section.

$$CO_2 = \frac{44}{12} \cdot [(F_g) \cdot (C_{gf}) \cdot \frac{MW}{MVC} \cdot 0.001 + (Feed) \cdot (C_{Feed}) - (Sinter) \cdot (C_{Sinter}) - (R) \cdot (C_R)] \quad (\text{Eq. Q-4})$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions from the sinter process (metric tons).

44/12 = Ratio of molecular weights,  $CO_2$  to carbon.

( $F_g$ ) = Annual volume of the gaseous fuel used (scf).

( $C_{gf}$ ) = Carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel).

MW = Molecular weight of the gaseous fuel (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf per kg-mole at standard conditions).

0.001 = Conversion factor from kg to metric tons.

(Feed) = Annual mass of sinter feed material (metric tons).

( $C_{Feed}$ ) = Carbon content of the mixed sinter feed materials that form the bed entering the sintering machine, from the carbon analysis results (expressed as a decimal fraction).



(Sinter) = Annual mass of sinter produced (metric tons).

(C<sub>Sinter</sub>) = Carbon content of the sinter pellets, from the carbon analysis results (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

(C<sub>R</sub>) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction).

(v) For EAFs, estimate CO<sub>2</sub> emissions using Equation Q-5 of this section.

$$\text{CO}_2 = \frac{44}{12} * \left[ (\text{Iron}) * (C_{\text{iron}}) + (\text{Scrap}) * (C_{\text{scrap}}) + (\text{Flux}) * (C_{\text{Flux}}) + (\text{Electrode}) * (C_{\text{Electrode}}) + (\text{Carbon}) * (C_{\text{Carbon}}) - (\text{Steel}) * (C_{\text{Steel}}) + (F_g) * (C_{\text{gr}}) * \frac{\text{MW}}{\text{MVC}} * 0.001 - (\text{Slag}) * (C_{\text{Slag}}) - (R) * (C_R) \right] \quad (\text{Eq. Q-5})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from the EAF (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

(Iron) = Annual mass of direct reduced iron (if any) charged to the furnace (metric tons).

(C<sub>Iron</sub>) = Carbon content of the direct reduced iron, from the carbon analysis results (expressed as a decimal fraction).

(Scrap) = Annual mass of ferrous scrap charged to the furnace (metric tons).

(C<sub>Scrap</sub>) = Carbon content of the ferrous scrap, from the carbon analysis results (expressed as a decimal fraction).

(Flux) = Annual mass of flux materials (e.g., limestone, dolomite) charged to the furnace (metric tons).

(C<sub>Flux</sub>) = Carbon content of the flux materials, from the carbon analysis results (expressed as a decimal fraction).

(Electrode) = Annual mass of carbon electrode consumed (metric tons).

(C<sub>Electrode</sub>) = Carbon content of the carbon electrode, from the carbon analysis results (expressed as a decimal fraction).

(Carbon) = Annual mass of carbonaceous materials (e.g., coal, coke) charged to the furnace (metric tons).

(C<sub>Carbon</sub>) = Carbon content of the carbonaceous materials, from the carbon analysis results (expressed as a decimal fraction).

(Steel) = Annual mass of molten raw steel produced by the furnace (metric tons).

(C<sub>Steel</sub>) = Carbon content of the steel, from the carbon analysis results (expressed as a decimal fraction).

(F<sub>g</sub>) = Annual volume of the gaseous fuel used (scf at 60 degrees F and one atmosphere).

(C<sub>gf</sub>) = Average carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel).

(MW) = Molecular weight of the gaseous fuel (kg/kg-mole).

(MVC) = Molar volume conversion factor (836.6 scf per kg-mole at standard conditions of 60 degrees F and one atmosphere).

(0.001) = Conversion factor from kg to metric tons.

(Slag) = Annual mass of slag produced by the furnace (metric tons).

(C<sub>Slag</sub>) = Carbon content of the slag, from the carbon analysis results (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

(C<sub>R</sub>) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction).

(vi) For decarburization vessels, estimate CO<sub>2</sub> emissions using Equation Q-6 of this section.

$$CO_2 = \frac{44}{12} * \{ (Steel) * [(C_{Steel_{in}}) - (C_{Steel_{out}})] - (R) * (C_R) \} \quad (\text{Eq. Q-6})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from the decarburization vessel (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

(Steel) = Annual mass of molten steel charged to the vessel (metric tons).

(C<sub>Steel<sub>in</sub></sub>) = Carbon content of the molten steel before decarburization, from the carbon analysis results (expressed as a decimal fraction).

(C<sub>Steel<sub>out</sub></sub>) = Carbon content of the molten steel after decarburization, from the carbon analysis results (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

(C<sub>R</sub>) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction).

(vii) For direct reduction furnaces, estimate CO<sub>2</sub> emissions using Equation Q-7 of this section.

$$CO_2 = \frac{44}{12} \cdot \left[ (F_g) \cdot (C_{gf}) \cdot \frac{MW}{MVC} \cdot 0.001 + (Ore) \cdot (C_{Ore}) \right. \\ \left. + (Carbon) \cdot (C_{Carbon}) + (Other) \cdot (C_{Other}) \right. \\ \left. - (Iron) \cdot (C_{Iron}) - (NM) \cdot (C_{NM}) - (R) \cdot (C_R) \right] \quad (\text{Eq. Q-7})$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions from the direct reduction furnace (metric tons).

$44/12$  = Ratio of molecular weights,  $CO_2$  to carbon.

$(F_g)$  = Annual volume of the gaseous fuel used (scf).

$(C_{gf})$  = Carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel).

$MW$  = Molecular weight of the gaseous fuel (kg/kg-mole).

$MVC$  = Molar volume conversion factor (849.5 scf per kg-mole at standard conditions).

0.001 = Conversion factor from kg to metric tons.

$(Ore)$  = Annual mass of iron ore or iron ore pellets fed to the furnace (metric tons).

$(C_{Ore})$  = Carbon content of the iron ore or iron ore pellets, from the carbon analysis results (expressed as a decimal fraction).

$(Carbon)$  = Annual mass of carbonaceous materials (e.g., coal, coke) charged to the furnace (metric tons).

$(C_{Carbon})$  = Carbon content of the carbonaceous materials, from the carbon analysis results (expressed as a decimal fraction).

$(Other)$  = Annual mass of other materials charged to the furnace (metric tons).

$(C_{Other})$  = Average carbon content of the other materials charged to the furnace, from the carbon analysis results (expressed as a decimal fraction).

$(Iron)$  = Annual mass of iron produced (metric tons).

$(C_{Iron})$  = Carbon content of the iron, from the carbon analysis results (expressed as a decimal fraction).

$(NM)$  = Annual mass of non-metallic materials produced by the furnace (metric tons).

(C<sub>NM</sub>) = Carbon content of the non-metallic materials, from the carbon analysis results (expressed as a decimal fraction).

(R) = Annual mass of air pollution control residue collected (metric tons).

(C<sub>R</sub>) = Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction).

(2) **Site-specific emission factor method.** Conduct a performance test and measure CO<sub>2</sub> emissions from all exhaust stacks for the process and measure either the feed rate of materials into the process or the production rate during the test as described in paragraphs (b)(2)(i) through (b)(2)(iv) of this section.

(i) You must measure the process production rate or process feed rate, as applicable, during the performance test according to the procedures in § 98.174(c)(5) and calculate the average rate for the test period in metric tons per hour.

(ii) You must calculate the hourly CO<sub>2</sub> emission rate using Equation Q-8 of this section and determine the average hourly CO<sub>2</sub> emission rate for the test.

$$CO_2 = 5.18 \times 10^{-7} C_{CO_2} Q \left( \frac{100 - \%H_2O}{100} \right) \quad (\text{Eq. Q-8})$$

Where:

CO<sub>2</sub> = CO<sub>2</sub> mass emission rate, corrected for moisture (metric tons/hr).

$5.18 \times 10^{-7}$  = Conversion factor (metric tons/scf-% CO<sub>2</sub>).

C<sub>CO<sub>2</sub></sub> = Hourly CO<sub>2</sub> concentration, dry basis (% CO<sub>2</sub>).

Q = Hourly stack gas volumetric flow rate (scfh).

%H<sub>2</sub>O = Hourly moisture percentage in the stack gas.

(iii) You must calculate a site-specific emission factor for the process in metric tons of CO<sub>2</sub> per metric ton of feed or production, as applicable, by dividing the average hourly CO<sub>2</sub> emission rate during the test by the average hourly feed or production rate during the test.

(iv) You must calculate CO<sub>2</sub> emissions for the process by multiplying the emission factor by the total amount of feed or production, as applicable, for the reporting period.

(c) You must determine emissions of CO<sub>2</sub> from the coke pushing process in mtCO<sub>2</sub>e by multiplying the metric tons of coal charged to the by-product recovery and non-recovery coke ovens during the reporting period by 0.008.

(d) If GHG emissions from a taconite indurating furnace, basic oxygen furnace, non-recovery coke oven battery, sinter process, EAF, decarburization vessel, or direct reduction furnace are vented through a stack equipped with a CEMS that complies with the Tier 4 methodology in subpart C of this part, or through the

same stack as any combustion unit or process equipment that reports CO<sub>2</sub> emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate process emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and comply with all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71956, Nov. 29, 2013; 81 FR 89258, Dec. 9, 2016; 89 FR 31928, Apr. 25, 2024]

## § 98.174 Monitoring and QA/QC requirements.

- (a) If you operate and maintain a CEMS that measures CO<sub>2</sub> emissions consistent with subpart C of this part, you must meet the monitoring and QA/QC requirements of § 98.34(c).
- (b) If you determine CO<sub>2</sub> emissions using the carbon mass balance procedure in § 98.173(b)(1), you must:
  - (1) Except as provided in paragraph (b)(4) of this section, determine the mass of each process input and output other than fuels using the same plant instruments or procedures that are used for accounting purposes (such as weigh hoppers, belt weigh feeders, weighed purchased quantities in shipments or containers, combination of bulk density and volume measurements, etc.), record the totals for each process input and output for each calendar month, and sum the monthly mass to determine the annual mass for each process input and output. Determine the mass rate of fuels using the procedures for combustion units in § 98.34. No determination of the mass of steel output from decarburization vessels is required.
  - (2) Except as provided in paragraph (b)(4) of this section, determine the carbon content of each process input and output annually for use in the applicable equations in § 98.173(b)(1) based on analyses provided by the supplier, analyses provided by material recyclers who manage process outputs for sale or use by other industries, or by the average carbon content determined by collecting and analyzing at least three samples each year using the standard methods specified in paragraphs (b)(2)(i) through (vii) of this section as applicable.
    - (i) ASTM C25-06, Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime (incorporated by reference, see § 98.7) for limestone, dolomite, and slag.
    - (ii) ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7) for coal, coke, and other carbonaceous materials.
    - (iii) ASTM E1915-07a, Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared-Absorption Spectrometry (incorporated by reference, see § 98.7) for iron ore, taconite pellets, and other iron-bearing materials.
    - (iv) ASTM E1019-08, Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques (incorporated by reference, see § 98.7) for iron and ferrous scrap.
    - (v) ASM CS-104 UNS No. G10460—Alloy Digest April 1985 (Carbon Steel of Medium Carbon Content) (incorporated by reference, see § 98.7); ISO/CSAPR 15349-1:1998, Unalloyed steel—Determination of low carbon content, Part 1: Infrared absorption method after

combustion in an electric resistance furnace (by peak separation) (1998-10-15) First Edition (incorporated by reference, see § 98.7); or ISO/CSAPR 15349-3:1998, Unalloyed steel-Determination of low carbon content Part 3: Infrared absorption method after combustion in an electric resistance furnace (with preheating) (1998-10-15) First Edition (incorporated by reference, see § 98.7) as applicable for steel.

- (vi) ASTM E415-17, Standard Test Method for Analysis of Carbon and Low-Alloy Steel by Spark Atomic Emission Spectrometry (incorporated by reference, see § 98.7) as applicable for steel.
  - (vii) For each process input that is a fuel, determine the carbon content and molecular weight (if applicable) using the applicable methods listed in § 98.34.
- (3) For solid ferrous materials charged to basic oxygen process furnaces or EAFs that differ in carbon content, you may determine a weighted average carbon content based on the carbon content of each type of ferrous material and the average weight percent of each type that is used. Examples of these different ferrous materials include carbon steel, low carbon steel, stainless steel, high alloy steel, pig iron, iron scrap, and direct reduced iron.
  - (4) If you document that a specific process input or output contributes less than one percent of the total mass of carbon into or out of the process, you do not have to determine the monthly mass or annual carbon content of that input or output.
  - (5) Except as provided in paragraph (b)(4) of this section, you must determine the annual carbon content and monthly mass rate of any input or output that contains carbon that is not listed in the equations in § 98.173(b)(1) using the procedures in paragraphs (b)(1) and (b)(2) of this section.
- (c) If you determine CO<sub>2</sub> emissions using the site-specific emission factor procedure in § 98.173(b)(2), you must:
- (1) Conduct an annual performance test that is based on representative performance (i.e., performance based on normal operating conditions) of the affected process.
  - (2)
    - (i) For the exhaust from basic oxygen furnaces, EAFs, decarburization vessels, and direct reduction furnaces, sample the furnace exhaust for at least three complete production cycles that start when the furnace is being charged and end after steel or iron and slag have been tapped. For EAFs that produce both carbon steel and stainless or specialty (low carbon) steel, develop an emission factor for the production of both types of steel.
    - (ii) For the exhaust from continuously charged EAFs, sample the exhaust for a period spanning at least three hours. For EAFs that produce both carbon steel and stainless or specialty (low carbon) steel, develop an emission factor for the production of both types of steel.
  - (3) For taconite indurating furnaces, non-recovery coke batteries, and sinter processes, sample for at least 3 hours.
  - (4) Conduct the stack test using EPA Method 3A at 40 CFR part 60, appendix A-2 to measure the CO<sub>2</sub> concentration, Method 2, 2A, 2C, 2D, or 2F at 40 CFR part 60, appendix A-1 or Method 26 at 40 CFR part 60, appendix A-2 to determine the stack gas volumetric flow rate, and Method 4 at 40 CFR part 60, at appendix A-3 to determine the moisture content of the stack gas.

- (5) Determine the mass rate of process feed or process production (as applicable) during the test using the same plant instruments or procedures that are used for accounting purposes (such as weigh hoppers, belt weigh feeders, combination of bulk density and volume measurements, etc.)
  - (6) If your process operates under different conditions as part of normal operations in such a manner that CO<sub>2</sub> emissions change by more than 20 percent (e.g., routine changes in the carbon content of the sinter feed or change in grade of product), you must perform emission testing and develop separate emission factors for these different operating conditions and determine emissions based on the number of hours the process operates and the production or feed rate (as applicable) at each specific different condition.
  - (7) If your EAF and decarburization vessel exhaust to a common emission control device and stack, you must sample each process in the ducts before the emissions are combined, sample each process when only one process is operating, or sample the combined emissions when both processes are operating and base the site-specific emission factor on the steel production rate of the EAF.
  - (8) The results of a performance test must include the analysis of samples, determination of emissions, and raw data. The performance test report must contain all information and data used to derive the emission factor.
- (d) For a coke pushing process, determine the metric tons of coal charged to the coke ovens and record the totals for each pushing process for each calendar month. Coal charged to coke ovens can be measured using weigh belts or a combination of measuring volume and bulk density.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71957, Nov. 29, 2013; 89 FR 31928, Apr. 25, 2024]

### § 98.175 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations in § 98.173 is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in the paragraphs (a) and (b) of this section. You must follow the missing data procedures in § 98.255(b) of subpart Y (Petroleum Refineries) of this part for flares burning coke oven gas or blast furnace gas. You must document and keep records of the procedures used for all such estimates.

- (a) Except as provided in § 98.174(b)(4), 100 percent data availability is required for the carbon content of inputs and outputs for facilities that estimate emissions using the carbon mass balance procedure in § 98.173(b)(1) or facilities that estimate emissions using the site-specific emission factor procedure in § 98.173(b)(2).
- (b) For missing records of the monthly mass or volume of carbon-containing inputs and outputs using the carbon mass balance procedure in § 98.173(b)(1), the substitute data value must be based on the best available estimate of the mass of the input or output material from all available process data or data used for accounting purposes.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71958, Nov. 29, 2013]

## § 98.176 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information required in paragraphs (a) through (h) of this section for each coke pushing operation; taconite indurating furnace; basic oxygen furnace; non-recovery coke oven battery; sinter process; EAF; decarburization vessel; direct reduction furnace; and flare burning coke oven gas or blast furnace gas. For reporting year 2010, the information required in paragraphs (a) through (h) of this section is not required for decarburization vessels that are not argon-oxygen decarburization vessels. For reporting year 2011 and each subsequent reporting year, the information in paragraphs (a) through (h) of this section must be reported for all decarburization vessels.

- (a) Unit identification number and annual CO<sub>2</sub> emissions (in metric tons).
- (b) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report the annual production quantity for the production unit (in metric tons) for taconite pellets, coke, sinter, iron, and raw steel.
- (c) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report the relevant information required under § 98.36 for the Tier 4 Calculation Methodology.
- (d) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must report for each process whether the emissions were determined using the carbon mass balance method in § 98.173(b)(1) or the site-specific emission factor method in § 98.173(b)(2).
- (e) If you use the carbon mass balance method in § 98.173(b)(1) to determine CO<sub>2</sub> emissions, you must, except as provided in § 98.174(b)(4), report the following information for each process:
  - (1) [Reserved]
  - (2) Whether the carbon content was determined from information from the supplier, material recycler, or by laboratory analysis, and if by laboratory analysis, the method used in § 98.174(b)(2).
  - (3)-(4) [Reserved]
  - (5) If you used the missing data procedures in § 98.175(b), you must report how the monthly mass for each process input or output with missing data was determined and the number of months the missing data procedures were used.
  - (6) The information specified in paragraphs (e)(6)(i) through (vi) of this section aggregated for all process units for which CO<sub>2</sub> emissions were determined using the mass balance method in § 98.173(b)(1), except as provided in § 98.174(b)(4).
    - (i) The annual mass (metric tons) of all gaseous, liquid, and solid fuels (combined) used in process units for which CO<sub>2</sub> emissions were determined using Equations Q-1 through Q-7 of § 98.173, calculated as specified in Equation Q-9 of this section.

$$Fuel = \sum_{i=1}^n \left( F_{g,i} * \frac{MW_i}{MVC} * 0.001 + F_{l,i} * \rho_{l,i} * 0.001 + F_{s,i} \right) \quad (\text{Eq. Q-9})$$

Where:

Fuel = Annual mass of all gaseous, liquid, and solid fuels used in process units (metric tons).

n = Number of process units where fuel is used.



$F_{g,i}$  = Annual volume of gaseous fuel combusted (" $F_g$ ") in Equations Q-1, Q-4 and Q-7 of § 98.173) for each process (scf).

$MW_i$  = Molecular weight of gaseous fuel used in each process (kg/kg-mole).

MVC = Molar volume conversion factor at standard conditions, as defined in § 98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.

$F_{l,i}$  = Annual volume of the liquid fuel combusted (" $F_l$ ") included in Equation Q-1) for each process unit (gallons).

$F_{s,i}$  = Annual mass of the solid fuel combusted (" $F_s$ ") in Equation Q-1) for each process unit (metric tons).

$\rho_{l,i}$  = Density of the liquid fuel (kg/gallon).

0.001 = Conversion factor from kg to metric tons.

- (ii) The annual mass (metric tons) of all non-fuel material inputs (combined) specified in Equations Q-1 through Q-7 of § 98.173, calculated as specified in Equation Q-10 of this section.

$$NFI = \sum_{i=1}^n \left( O + Iron + Scrap + Flux + Carbon + Coal + Feed + Electrode + Steel_{in} + Ore + Other \right) \quad (\text{Eq. Q-10})$$

Where:

NFI = Annual mass of all non-fuel inputs (to all process unit types) specified in Equations Q-1 through Q-7 of § 98.173 (metric tons).

$n$  = Number of process units, all process types.

$O$  = Annual mass of greenball (taconite) pellets fed to the taconite furnace(s) (metric tons).

Iron = Annual mass of molten iron charged to the basic oxygen furnace(s) plus annual mass of direct reduced iron charged to the EAF(s) (metric tons).

Scrap = Annual mass of ferrous scrap charged to the basic oxygen furnace(s) and EAF(s) (metric tons).

Flux = Annual mass of flux materials charged to the basic oxygen furnace(s) and EAF(s) (metric tons).

Carbon = Annual mass of carbonaceous materials (e.g., coal, coke) charged to the basic oxygen furnace(s), EAF(s), and direct reduction furnace(s) (metric tons).

Coal = Annual mass of coal charged to the coke oven battery(s) (metric tons).

Feed = Annual mass of sinter feed material charged to the sinter process(es) (metric tons).

Electrode = Annual mass of carbon electrode consumed in the EAF(s) (metric tons).

$Steel_{in}$  = Annual mass of molten steel charged to the decarburization vessels (metric tons).

Ore = Annual mass of iron ore or iron ore pellets fed to the direct reduction furnace(s) (metric tons).

Other = Annual mass of other materials charged to the direction reduction furnace(s) (metric tons).

- (iii) The annual mass (metric tons) of all solid and liquid products and byproducts (combined) specified in Equations Q-1 through Q-7 of § 98.173, calculated as specified in Equation Q-11 of this section.

$$Products = \sum_{i=1}^n (P + R + Steel_{out} + Slag + Coke + Sinter + Iron + NM) \quad (Eq. Q-11)$$

Where:

Products = Annual mass of all solid and liquid products and by-products (from all process units) specified in Equations Q-1 through Q-7 of § 98.173 (metric tons).

n = Number of process units, all types.

P = Annual mass of fired pellets produced by the taconite furnace (metric tons).

R = Annual mass of air pollution control residue from all process units (metric tons).

$Steel_{out}$  = Annual mass of steel produced by the basic oxygen furnace(s), EAF(s) and decarburization vessel(s) (metric tons).

Slag = Annual mass of slag produced by the basic oxygen furnace(s) and EAF(s) (metric tons).

Coke = Annual mass of coke produced by the non-recovery coke batteries (metric tons).

Sinter = Annual mass of sinter produced from the sinter process(es) (metric tons).

Iron = Annual mass of iron produced from the direct reduction furnace (metric tons).

NM = Annual mass of non-metallic materials produced by the direct reduction furnace (metric tons).

- (iv) The weighted average carbon content of all gaseous, liquid, and solid fuels (combined) included in Equation Q-9 of this section, calculated as specified in Equation Q-12 of this section.

$$CF_{avg} = \frac{\sum_{i=1}^n (F_{g,i} * \frac{MW_i}{MVC} * C_{gf,i} * 0.001 + F_{l,i} * C_{lf,i} * 0.001 + F_{s,i} * C_{sf})}{Fuel} \quad (Eq. Q-12)$$

Where:

$CF_{avg}$  = Weighted average carbon content of all gaseous, liquid, and solid fuels included in Equation Q-9 of this section (weight fraction).

$n$  = Number of gaseous, liquid, and solid fuel inputs to each process unit as used in Equation Q-9 of this section.

$C_{gf,i}$  = Average carbon content of the gaseous fuel used in each process, from the fuel analysis results (kg C per kg of fuel).

$C_{lf,i}$  = Carbon content of the liquid fuel used in each process, from the fuel analysis results (kg C per gallon of fuel).

$C_{sf}$  = Carbon content of the solid fuel used in each process, from the fuel analysis (expressed as a decimal fraction, e.g., 95% = 0.95).

Fuel = Annual mass of all gaseous, liquid, and solid fuels used in process units (metric tons), as calculated in Equation Q-9.

- (v) The weighted average carbon content of all non-fuel inputs to all process units (combined) included in Equation Q-10 of this section, calculated as specified in Equation Q-13 of this section.

$$CI_{avg} = \frac{(\sum_{i=1}^n NFI_i * C_{NFIi})}{NFI} \quad (\text{Eq. Q-13})$$

Where:

$CI_{avg}$  = Weighted average carbon content of all non-fuel inputs to all process units included in Equation Q-10 of this section (weight fraction).

$n$  = Number of non-fuel inputs to all process units as used in Equation Q-10.

$NFI_i$  = Annual mass of each non-fuel input used in Equation Q-10 (metric tons).

$C_{NFIi}$  = Average carbon content of each non-fuel input used in Equation Q-10 (expressed as a decimal fraction).

$NFI$  = Total of all non-fuel inputs to all process units (metric tons).

- (vi) The weighted average carbon content of all solid and liquid products and byproducts from all process units (combined) included in Equation Q-11 of this section, calculated as specified in Equation Q-14 of this section.

$$CP_{avg} = \frac{(\sum_{i=1}^n Product_i * C_{Pi})}{Products} \quad (\text{Eq. Q-14})$$

Where:

$CP_{avg}$  = Weighted average carbon content of all solid and liquid products and byproducts from all process units (weight fraction).

$n$  = Number of products and byproducts from each process unit as used in Equation Q-11 of this section.

Product<sub>i</sub> = Annual mass of each product or byproduct used in Equation Q-11 (metric tons).

C<sub>p,i</sub> = Average carbon content of each product or byproduct used in Equation Q-11 (expressed as a decimal fraction).

Products = Mass of all products and byproducts from all process units, calculated in Equation Q-11 (metric tons).

- (f) If you used the site-specific emission factor method in § 98.173(b)(2) to determine CO<sub>2</sub> emissions, you must report the following information for each process:
  - (1) The measured average hourly CO<sub>2</sub> emission rate during the test (in metric tons per hour).
  - (2)-(4) [Reserved]
- (g) For each unit, the type of unit, the annual production capacity, and annual operating hours.
- (h) For flares burning coke oven gas or blast furnace gas, the information specified in § 98.256(e) of subpart Y (Petroleum Refineries) of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71958, Nov. 29, 2013; 79 FR 63787, Oct. 24, 2014; 81 FR 89258, Dec. 9, 2016; 89 FR 31928, Apr. 25, 2024]

### § 98.177 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (f) of this section, as applicable. Facilities that use CEMS to measure emissions must also retain records of the verification data required for the Tier 4 Calculating Methodology in § 98.36(e).

- (a) Records of all analyses and calculations conducted, including all information reported as required under § 98.176.
- (b) When the carbon mass balance method is used to estimate emissions for a process, the monthly mass of each process input and output that are used to determine the annual mass, except that no determination of the mass of steel output from decarburization vessels is required.
- (c) Production capacity (in metric tons per year) for the production of taconite pellets, coke, sinter, iron, and raw steel.
- (d) Annual operating hours for each taconite indurating furnace, basic oxygen furnace, non-recovery coke oven battery, sinter process, electric arc furnace, decarburization vessel, and direct reduction furnace.
- (e) Facilities must keep records that include a detailed explanation of how company records or measurements are used to determine all sources of carbon input and output and the metric tons of coal charged to the coke ovens (e.g., weigh belts, a combination of measuring volume and bulk density). You also must document the procedures used to ensure the accuracy of the measurements of fuel usage including, but not limited to, calibration of weighing equipment, fuel flow meters, coal usage including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.

- (f) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (f)(1) through (9) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (f)(1) through (9) of this section.
- (1) The data in paragraphs (f)(1)(i) through (xxv) of this section for each applicable taconite indurating furnace for which the carbon mass balance method of reporting is used.
- (i) Annual mass of each solid fuel (metric tons) (Equation Q-1 of § 98.173).
  - (ii) Carbon content of each solid fuel, from the fuel analysis (expressed as a decimal fraction) (Equation Q-1).
  - (iii) Annual volume of each gaseous fuel (scf) (Equation Q-1).
  - (iv) Average carbon content of each gaseous fuel, from the fuel analysis results (kg C per kg of fuel) (Equation Q-1).
  - (v) Molecular weight of each gaseous fuel (kg/kg-mole) (Equation Q-1).
  - (vi) Annual volume of each liquid fuel (gallons) (Equation Q-1).
  - (vii) Carbon content of each liquid fuel, from the fuel analysis results (kg C per gallon of fuel) (Equation Q-1).
  - (viii) Annual mass of the greenball (taconite) pellets fed to the furnace (metric tons) (Equation Q-1).
  - (ix) Carbon content of the greenball (taconite) pellets, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-1).
  - (x) Annual mass of fired pellets produced by the furnace (metric tons) (Equation Q-1).
  - (xi) Carbon content of the fired pellets, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-1).
  - (xii) Annual mass of air pollution control residue collected (metric tons) (Equation Q-1).
  - (xiii) Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-1).
  - (xiv) Annual mass of each other solid input containing carbon fed to each furnace (metric tons) (Equation Q-1).
  - (xv) Carbon content of each other solid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-1).
  - (xvi) Annual mass of each other solid output containing carbon produced by each furnace (metric tons) (Equation Q-1).
  - (xvii) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-1).
  - (xviii) Annual mass of each other gaseous input containing carbon fed to each furnace (metric tons) (Equation Q-1).
  - (xix) Carbon content of each other gaseous input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-1).

- (xx) Annual mass of each other gaseous output containing carbon produced by each furnace (metric tons) (Equation Q-1).
- (xxi) Carbon content of each other gaseous output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-1).
- (xxii) Annual mass of each other liquid input containing carbon fed to each furnace (metric tons) (Equation Q-1).
- (xxiii) Carbon content of each other liquid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-1).
- (xxiv) Annual mass of each other liquid output containing carbon produced by each furnace (metric tons) (Equation Q-1).
- (xxv) Carbon content of each other liquid output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-1).
- (2) The data in paragraphs (f)(2)(i) through (xxvi) of this section for each applicable basic oxygen process furnace for which the carbon mass balance method of reporting is used.
  - (i) Annual mass of molten iron charged to the furnace (metric tons) (Equation Q-2 of § 98.173).
  - (ii) Carbon content of the molten iron charged to the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-2).
  - (iii) Annual mass of ferrous scrap charged to the furnace (metric tons) (Equation Q-2).
  - (iv) Carbon content of the ferrous scrap charged to the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-2).
  - (v) Annual mass of the flux materials (e.g., limestone, dolomite) charged to the furnace (metric tons) (Equation Q-2).
  - (vi) Carbon content of the flux materials charged to the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-2).
  - (vii) Annual mass of the carbonaceous materials (e.g., coal, coke) charged to the furnace (metric tons) (Equation Q-2).
  - (viii) Carbon content of the carbonaceous materials charged to the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-2).
  - (ix) Annual mass of molten raw steel produced by the furnace (metric tons) (Equation Q-2).
  - (x) Carbon content of the steel produced by the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-2).
  - (xi) Annual mass of slag produced by the furnace (metric tons) (Equation Q-2).
  - (xii) Carbon content of the slag produced by the furnace, from the carbon analysis (expressed as a decimal fraction) (Equation Q-2).
  - (xiii) Annual mass of air pollution control residue collected for the furnace (metric tons) (Equation Q-2).

- (xiv) Carbon content of the air pollution control residue collected for the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-2).
- (xv) Annual mass of each other solid input containing carbon fed to each furnace (metric tons) (Equation Q-2).
- (xvi) Carbon content of each other solid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-2).
- (xvii) Annual mass of each other solid output containing carbon produced by each furnace (metric tons) (Equation Q-2).
- (xviii) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-2).
- (xix) Annual mass of each other gaseous input containing carbon fed to each furnace (metric tons) (Equation Q-2).
- (xx) Carbon content of each other gaseous input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-2).
- (xxi) Annual mass of each other gaseous output containing carbon produced by each furnace (metric tons) (Equation Q-2).
- (xxii) Carbon content of each other gaseous output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-2).
- (xxiii) Annual mass of each other liquid input containing carbon fed to each furnace (metric tons) (Equation Q-2).
- (xxiv) Carbon content of each other liquid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-2).
- (xxv) Annual mass of each other liquid output containing carbon produced by each furnace (metric tons) (Equation Q-2).
- (xxvi) Carbon content of each other liquid output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-2).
- (3) The data in paragraphs (f)(3)(i) through (xviii) of this section for each applicable non-recovery coke oven battery for which the carbon mass balance method of reporting is used.
  - (i) Annual mass of coal charged to the battery (metric tons) (Equation Q-3 of § 98.173).
  - (ii) Carbon content of the coal, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-3).
  - (iii) Annual mass of coke produced by the battery (metric tons) (Equation Q-3).
  - (iv) Carbon content of the coke, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-3).
  - (v) Annual mass of air pollution control residue collected (metric tons) (Equation Q-3).
  - (vi) Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-3).

- (vii) Annual mass of each other solid input containing carbon fed to each battery (metric tons) (Equation Q-3).
- (viii) Carbon content of each other solid input containing carbon fed to each battery (expressed as a decimal fraction) (Equation Q-3).
- (ix) Annual mass of each other solid output containing carbon produced by each battery (metric tons) (Equation Q-3).
- (x) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-3).
- (xi) Annual mass of each other gaseous input containing carbon fed to each battery (metric tons) (Equation Q-3).
- (xii) Carbon content of each other gaseous input containing carbon fed to each battery (expressed as a decimal fraction) (Equation Q-3).
- (xiii) Annual mass of each other gaseous output containing carbon produced by each battery (metric tons) (Equation Q-3).
- (xiv) Carbon content of each other gaseous output containing carbon produced by each battery (expressed as a decimal fraction) (Equation Q-3).
- (xv) Annual mass of each other liquid input containing carbon fed to each battery (metric tons) (Equation Q-3).
- (xvi) Carbon content of each other liquid input containing carbon fed to each battery (expressed as a decimal fraction) (Equation Q-3).
- (xvii) Annual mass of each other liquid output containing carbon produced by each battery (metric tons) (Equation Q-3).
- (xviii) Carbon content of each other liquid output containing carbon produced by each battery (expressed as a decimal fraction) (Equation Q-3).
- (4) The data in paragraphs (f)(4)(i) through (xxi) of this section for each applicable sinter process for which the carbon mass balance method of reporting is used.
  - (i) Annual volume of the gaseous fuel (scf) (Equation Q-4 of § 98.173).
  - (ii) Carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel) (Equation Q-4).
  - (iii) Molecular weight of the gaseous fuel (kg/kg-mole) (Equation Q-4).
  - (iv) Annual mass of sinter feed material (metric tons) (Equation Q-4).
  - (v) Carbon content of the mixed sinter feed materials that form the bed entering the sintering machine, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-4).
  - (vi) Annual mass of sinter produced (metric tons) (Equation Q-4).
  - (vii) Carbon content of the sinter pellets, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-4).
  - (viii) Annual mass of air pollution control residue collected (metric tons) (Equation Q-4).



- (ix) Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-4).
- (x) Annual mass of each other solid input containing carbon fed to each sinter process (metric tons) (Equation Q-4).
- (xi) Carbon content of each other solid input containing carbon fed to each sinter process (expressed as a decimal fraction) (Equation Q-4).
- (xii) Annual mass of each other solid output containing carbon produced by each sinter process (metric tons) (Equation Q-4).
- (xiii) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-4).
- (xiv) Annual mass of each other gaseous input containing carbon fed to each sinter process (metric tons) (Equation Q-4).
- (xv) Carbon content of each other gaseous input containing carbon fed to each sinter process (expressed as a decimal fraction) (Equation Q-4).
- (xvi) Annual mass of each other gaseous output containing carbon produced by each sinter process (metric tons) (Equation Q-4).
- (xvii) Carbon content of each other gaseous output containing carbon produced by each sinter process (expressed as a decimal fraction) (Equation Q-4).
- (xviii) Annual mass of each other liquid input containing carbon fed to each sinter process (metric tons) (Equation Q-4).
- (xix) Carbon content of each other liquid input containing carbon fed to each sinter process (expressed as a decimal fraction) (Equation Q-4).
- (xx) Annual mass of each other liquid output containing carbon produced by each sinter process (metric tons) (Equation Q-4).
- (xxi) Carbon content of each other liquid output containing carbon produced by each sinter process (expressed as a decimal fraction) (Equation Q-4).
- (5) The data in paragraphs (f)(5)(i) through (xxxi) of this section for each applicable electric arc furnace for which the carbon mass balance method of reporting is used.
  - (i) Annual mass of direct reduced iron (if any) charged to the furnace (metric tons) (Equation Q-5 of § 98.173).
  - (ii) Carbon content of the direct reduced iron, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5)
  - (iii) Annual mass of ferrous scrap charged to the furnace (metric tons) (Equation Q-5).
  - (iv) Carbon content of the ferrous scrap, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5).
  - (v) Annual mass of flux materials (e.g., limestone, dolomite) charged to the furnace (metric tons) (Equation Q-5).

- (vi) Carbon content of the flux materials, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5).
- (vii) Annual mass of carbon electrode consumed (metric tons) (Equation Q-5).
- (viii) Carbon content of the carbon electrode, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5).
- (ix) Annual mass of carbonaceous materials (e.g., coal, coke) charged to the furnace (metric tons) (Equation Q-5).
- (x) Carbon content of the carbonaceous materials, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5).
- (xi) Annual mass of molten raw steel produced by the furnace (metric tons) (Equation Q-5).
- (xii) Carbon content of the steel, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5).
- (xiii) Annual volume of the gaseous fuel (scf at 60F and 1 atm) (Equation Q-5).
- (xiv) Average carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel) (Equation Q-5).
- (xv) Molecular weight of the gaseous fuel (kg/kg-mole) (Equation Q-5).
- (xvi) Annual mass of slag produced by the furnace (metric tons) (Equation Q-5).
- (xvii) Carbon content of the slag, from the carbon analysis (expressed as a decimal fraction) (Equation Q-5).
- (xviii) Annual mass of air pollution control residue collected (metric tons) (Equation Q-5).
- (xix) Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-5).
- (xx) Annual mass of each other solid input containing carbon fed to each furnace (metric tons) (Equation Q-5).
- (xxi) Carbon content of each other solid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-5).
- (xxii) Annual mass of each other solid output containing carbon produced by each furnace (metric tons) (Equation Q-5).
- (xxiii) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-5).
- (xxiv) Annual mass of each other gaseous input containing carbon fed to each furnace (metric tons) (Equation Q-5).
- (xxv) Carbon content of each other gaseous input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-5).
- (xxvi) Annual mass of each other gaseous output containing carbon produced by each furnace (metric tons) (Equation Q-5).

- (xxvii) Carbon content of each other gaseous output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-5).
- (xxviii) Annual mass of each other liquid input containing carbon fed to each furnace (metric tons) (Equation Q-5).
- (xxix) Carbon content of each other liquid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-5).
- (xxx) Annual mass of each other liquid output containing carbon produced by each furnace (metric tons) (Equation Q-5).
- (xxxi) Carbon content of each other liquid output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-5).
- (6) The data in paragraphs (f)(6)(i) through (xvii) of this section for each applicable decarburization vessel for which the carbon mass balance method of reporting is used.
  - (i) Annual mass of molten steel charged to the vessel (metric tons) (Equation Q-6 of § 98.173).
  - (ii) Carbon content of the molten steel before decarburization, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-6).
  - (iii) Carbon content of the molten steel after decarburization, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-6).
  - (iv) Annual mass of air pollution control residue collected (metric tons) (Equation Q-6).
  - (v) Carbon content of the air pollution control residue, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-6).
  - (vi) Annual mass of each other solid input containing carbon fed to each decarburization vessel (metric tons) (Equation Q-6).
  - (vii) Carbon content of each other solid input containing carbon fed to each decarburization vessel (expressed as a decimal fraction) (Equation Q-6).
  - (viii) Annual mass of each other solid output containing carbon produced by each decarburization vessel (metric tons) (Equation Q-6).
  - (ix) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-6).
  - (x) Annual mass of each other gaseous input containing carbon fed to each decarburization vessel (metric tons) (Equation Q-6).
  - (xi) Carbon content of each other gaseous input containing carbon fed to each decarburization vessel (expressed as a decimal fraction) (Equation Q-6).
  - (xii) Annual mass of each other gaseous output containing carbon produced by each decarburization vessel (metric tons) (Equation Q-6).
  - (xiii) Carbon content of each other gaseous output containing carbon produced by each decarburization vessel (expressed as a decimal fraction) (Equation Q-6).
  - (xiv) Annual mass of each other liquid input containing carbon fed to each decarburization vessel (metric tons) (Equation Q-6).

- (xv) Carbon content of each other liquid input containing carbon fed to each decarburization vessel (expressed as a decimal fraction) (Equation Q-6).
  - (xvi) Annual mass of each other liquid output containing carbon produced by each decarburization vessel (metric tons) (Equation Q-6).
  - (xvii) Carbon content of each other liquid output containing carbon produced by each decarburization vessel (expressed as a decimal fraction) (Equation Q-6).
- (7) The data in paragraphs (f)(7)(i) through (xxvii) of this section for each applicable direct reduction furnace for which the carbon mass balance method of reporting is used.
- (i) Annual volume of the gaseous fuel (scf at 68F and 1 atm) (Equation Q-7 of § 98.173).
  - (ii) Average carbon content of the gaseous fuel, from the fuel analysis results (kg C per kg of fuel) (Equation Q-7).
  - (iii) Molecular weight of the gaseous fuel (kg/kg-mole) (Equation Q-7).
  - (iv) Annual mass of iron ore or iron pellets fed to the furnace (metric tons) (Equation Q-7).
  - (v) Carbon content of the iron ore or iron pellets, from the carbon analysis (expressed as a decimal fraction) (Equation Q-7).
  - (vi) Annual mass of carbonaceous materials (e.g., coal, coke) charged to the furnace (metric tons) (Equation Q-7).
  - (vii) Carbon content of the carbonaceous materials, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-7).
  - (viii) Annual mass of each other material charged to the furnace (metric tons) (Equation Q-7).
  - (ix) Average carbon content of each other material charged to the furnace, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-7).
  - (x) Annual mass of iron produced (metric tons) (Equation Q-7).
  - (xi) Carbon content of the iron produced, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-7).
  - (xii) Annual mass of non-metallic materials produced by the furnace (metric tons) (Equation Q-7).
  - (xiii) Carbon content of the non-metallic materials produced, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-7).
  - (xiv) Annual mass of air pollution control residue collected (metric tons) (Equation Q-7).
  - (xv) Carbon content of the air pollution control residue collected, from the carbon analysis results (expressed as a decimal fraction) (Equation Q-7).
  - (xvi) Annual mass of each other solid input containing carbon fed to each furnace (metric tons) (Equation Q-7).
  - (xvii) Carbon content of each other solid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-7).
  - (xviii) Annual mass of each other solid output containing carbon produced by each furnace (metric tons) (Equation Q-7).

- (xix) Carbon content of each other solid output containing carbon (expressed as a decimal fraction) (Equation Q-7).
- (xx) Annual mass of each other gaseous input containing carbon fed to each furnace (metric tons) (Equation Q-7).
- (xxi) Carbon content of each other gaseous input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-7).
- (xxii) Annual mass of each other gaseous output containing carbon produced by each furnace (metric tons) (Equation Q-7).
- (xxiii) Carbon content of each other gaseous output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-7).
- (xxiv) Annual mass of each other liquid input containing carbon fed to each furnace (metric tons) (Equation Q-7).
- (xxv) Carbon content of each other liquid input containing carbon fed to each furnace (expressed as a decimal fraction) (Equation Q-7).
- (xxvi) Annual mass of each other liquid output containing carbon produced by each furnace (metric tons) (Equation Q-7).
- (xxvii) Carbon content of each other liquid output containing carbon produced by each furnace (expressed as a decimal fraction) (Equation Q-7).
- (8) The data in paragraphs (f)(8)(i) and (ii) of this section for each process unit for which the site-specific emission factor method was used.
  - (i) Average hourly feed or production rate, as applicable, during the test (metric tons/hour) (as used in § 98.173(b)(2)(iii)).
  - (ii) Annual total feed or production, as applicable (metric tons) (as used in § 98.173(b)(2)(iv)).
- (9) Total coal charged to the coke ovens for each process (metric tons/year)(as used in § 98.173(c)).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71958, Nov. 29, 2013; 79 FR 63788, Oct. 24, 2014]

## § 98.178 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart R—Lead Production

### § 98.180 Definition of the source category.

The lead production source category consists of primary lead smelters and secondary lead smelters. A primary lead smelter is a facility engaged in the production of lead metal from lead sulfide ore concentrates through the use of pyrometallurgical techniques. A secondary lead smelter is a facility at which lead-bearing scrap materials (including but not limited to, lead-acid batteries) are recycled by smelting into elemental lead or lead alloys.

## § 98.181 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a lead production process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

## § 98.182 GHGs to report.

You must report:

- (a) Process CO<sub>2</sub> emissions from each smelting furnace used for lead production.
- (b) CO<sub>2</sub> combustion emissions from each smelting furnace used for lead production.
- (c) CH<sub>4</sub> and N<sub>2</sub>O combustion emissions from each smelting furnace used for lead production. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (d) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit other than smelting furnaces used for lead production. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

## § 98.183 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each smelting furnace using the procedure in paragraphs (a) and (b) of this section.

- (a) For each smelting furnace that meets the conditions specified in § 98.33(b)(4)(ii) or (b)(4)(iii), you must calculate and report combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) For each smelting furnace that is not subject to the requirements in paragraph (a) of this section, calculate and report the process and combustion CO<sub>2</sub> emissions from the smelting furnace by using the procedure in either paragraph (b)(1) or (b)(2) of this section.
  - (1) Calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
  - (2) Calculate and report process and combustion CO<sub>2</sub> emissions separately using the procedures specified in paragraphs (b)(2)(i) through (b)(2)(iii) of this section.
    - (i) For each smelting furnace, determine the annual mass of carbon in each carbon-containing material, other than fuel, that is fed, charged, or otherwise introduced into the smelting furnace and estimate annual process CO<sub>2</sub> emissions using Equation R-1 of this section. Carbon-containing materials include carbonaceous reducing agents. If you document that a specific material contributes less than 1 percent of the total carbon into the process, you do not have to include the material in your calculation using Equation R-1 of this section.

$$E_{CO_2} = \frac{44}{12} \times \frac{2000}{2205} \times \left[ \{ Ore \times C_{Ore} \} + \{ Scrap \times C_{Scrap} \} + \{ Flux \times C_{Flux} \} + \{ Carbon \times C_{Carbon} \} + \{ Other \times C_{Other} \} \right] \quad (Eq. R-1)$$

Where:

$E_{CO_2}$  = Annual process CO<sub>2</sub> emissions from an individual smelting furnace (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

2000/2205 = Conversion factor to convert tons to metric tons.

Ore = Annual mass of lead ore charged to the smelting furnace (tons).

$C_{Ore}$  = Carbon content of the lead ore, from the carbon analysis results (percent by weight, expressed as a decimal fraction).

Scrap = Annual mass of lead scrap charged to the smelting furnace (tons).

$C_{Scrap}$  = Carbon content of the lead scrap, from the carbon analysis (percent by weight, expressed as a decimal fraction).

Flux = Annual mass of flux materials (e.g., limestone, dolomite) charged to the smelting furnace (tons).

$C_{Flux}$  = Carbon content of the flux materials, from the carbon analysis (percent by weight, expressed as a decimal fraction).

Carbon = Annual mass of carbonaceous materials (e.g., coal, coke) charged to the smelting furnace (tons).

$C_{Carbon}$  = Carbon content of the carbonaceous materials, from the carbon analysis (percent by weight, expressed as a decimal fraction).

Other = Annual mass of any other material containing carbon, other than fuel, fed, charged, or otherwise introduced into the smelting furnace (tons).

$C_{Other}$  = Carbon content of the other material from the carbon analysis results (percent by weight, expressed as a decimal fraction).

- (ii) Determine the combined annual process CO<sub>2</sub> emissions from the smelting furnaces at your facility using Equation R-2 of this section.

$$CO_2 = \sum_{k=1}^k E_{CO_2k} \quad (Eq. R-2)$$

Where:

CO<sub>2</sub> = Annual process CO<sub>2</sub> emissions from smelting furnaces at facility used for lead production (metric tons).

$E_{CO_2k}$  = Annual process CO<sub>2</sub> emissions from smelting furnace k calculated using Equation R-1 of this section (metric tons/year).

k = Total number of smelting furnaces at facility used for lead production.

- (iii) Calculate and report under subpart C of this part (General Stationary Fuel Combustion Sources) the combustion CO<sub>2</sub> emissions from the smelting furnaces according to the applicable requirements in subpart C.

## § 98.184 Monitoring and QA/QC requirements.

If you determine process CO<sub>2</sub> emissions using the carbon mass balance procedure in § 98.183(b)(2)(i) and (b)(2)(ii), you must meet the requirements specified in paragraphs (a) and (b) of this section.

- (a) Determine the annual mass for each material used for the calculations of annual process CO<sub>2</sub> emissions using Equation R-1 of this subpart by summing the monthly mass for the material determined for each month of the calendar year. The monthly mass may be determined using plant instruments used for accounting purposes, including either direct measurement of the quantity of the material placed in the unit or by calculations using process operating information.
- (b) For each material identified in paragraph (a) of this section, you must determine the average carbon content of the material consumed or used in the calendar year using the methods specified in either paragraph (b)(1) or (b)(2) of this section. If you document that a specific process input or output contributes less than one percent of the total mass of carbon into or out of the process, you do not have to determine the monthly mass or annual carbon content of that input or output.
  - (1) Information provided by your material supplier.
  - (2) Collecting and analyzing at least three representative samples of the material each year. The carbon content of the material must be analyzed at least annually using the methods (and their QA/QC procedures) specified in paragraphs (b)(2)(i) through (b)(2)(iii) of this section, as applicable.
    - (i) ASTM E1941-04, Standard Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys (incorporated by reference, see § 98.7) for analysis of metal ore and alloy product.
    - (ii) ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7), for analysis of carbonaceous reducing agents and carbon electrodes.
    - (iii) ASTM C25-06, Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime (incorporated by reference, see § 98.7) for analysis of flux materials such as limestone or dolomite.

## § 98.185 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations in § 98.183 is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in the paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) For each missing data for the carbon content for the smelting furnaces at your facility that estimate annual process CO<sub>2</sub> emissions using the carbon mass balance procedure in § 98.183(b)(2)(i) and (ii), 100 percent data availability is required. You must repeat the test for average carbon contents of inputs according to the procedures in § 98.184(b) if data are missing.



- (b) For missing records of the monthly mass of carbon-containing materials, the substitute data value must be based the best available estimate of the mass of the material from all available process data or data used for accounting purposes (such as purchase records).

### § 98.186 Data reporting procedures.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) or (b) of this section, as applicable.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions according to the requirements in § 98.183(a) or (b)(1), then you must report under this subpart the relevant information required by § 98.36 and the information specified in paragraphs (a)(1) through (a)(4) of this section.
  - (1) Identification number of each smelting furnace.
  - (2) Annual lead product production capacity (tons).
  - (3) Annual production for each lead product (tons).
  - (4) Total number of smelting furnaces at facility used for lead production.
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, and you measure CO<sub>2</sub> emissions according to the requirements in § 98.183(b)(2)(i) and (b)(2)(ii), then you must report the information specified in paragraphs (b)(1) through (b)(9) of this section.
  - (1) Identification number of each smelting furnace.
  - (2) Annual process CO<sub>2</sub> emissions (in metric tons) from each smelting furnace as determined by Equation R-1 of this subpart.
  - (3) Annual lead product production capacity for the facility and each smelting furnace(tons).
  - (4) Annual production for each lead product (tons).
  - (5) Total number of smelting furnaces at facility used for production of lead products reported in paragraph (b)(4) of this section.
  - (6)-(7) [Reserved]
  - (8) List the method used for the determination of carbon content for each material used for the calculation of annual process CO<sub>2</sub> emissions using Equation R-1 of § 98.183 for each smelting furnace (e.g., supplier provided information, analyses of representative samples you collected).
  - (9) If you use the missing data procedures in § 98.185(b), you must report how the monthly mass of carbon-containing materials with missing data was determined and the number of months the missing data procedures were used.

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63792, Oct. 24, 2014]

### § 98.187 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records of the information specified in paragraphs (a) through (d) of this section, as applicable to the smelting furnaces at your facility.

- (a) If a CEMS is used to measure combined process and combustion CO<sub>2</sub> emissions according to the requirements in § 98.183(a) or (b)(1), then you must retain the records required for the Tier 4 Calculation Methodology in § 98.37 and the information specified in paragraphs (a)(1) through (a)(3) of this section.
  - (1) Monthly smelting furnace production quantity for each lead product (tons).
  - (2) Number of smelting furnace operating hours each month.
  - (3) Number of smelting furnace operating hours in calendar year.
- (b) If the carbon mass balance procedure is used to determine process CO<sub>2</sub> emissions according to the requirements in § 98.183(b)(2)(i) and (b)(2)(ii), then you must retain under this subpart the records specified in paragraphs (b)(1) through (b)(5) of this section.
  - (1) Monthly smelting furnace production quantity for each lead product (tons).
  - (2) Number of smelting furnace operating hours each month.
  - (3) Number of smelting furnace operating hours in calendar year.
  - (4) Monthly material quantity consumed, used, or produced for each material included for the calculations of annual process CO<sub>2</sub> emissions using Equation R-1 of this subpart (tons).
  - (5) Average carbon content determined and records of the supplier provided information or analyses used for the determination for each material included for the calculations of annual process CO<sub>2</sub> emissions using Equation R-1 of this subpart.
- (c) You must keep records that include a detailed explanation of how company records of measurements are used to estimate the carbon input to each smelting furnace, including documentation of any materials excluded from Equation R-1 of this subpart that contribute less than 1 percent of the total carbon into or out of the process. You also must document the procedures used to ensure the accuracy of the measurements of materials fed, charged, or placed in an smelting furnace including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (d) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (10) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (10) of this section.
  - (1) Annual mass of lead ore charged to each smelting furnace (tons) (Equation R-1 of § 98.183).
  - (2) Carbon content of the lead ore per furnace, from the carbon analysis results (percent by weight, expressed as a decimal fraction) (Equation R-1).
  - (3) Annual mass of lead scrap charged to each smelting furnace (tons) (Equation R-1).
  - (4) Carbon content of the lead scrap per furnace, from the carbon analysis (percent by weight, expressed as a decimal fraction) (Equation R-1).
  - (5) Annual mass of flux materials (e.g., limestone, dolomite) charged to each smelting furnace (tons) (Equation R-1).
  - (6) Carbon content of the flux materials per furnace, from the carbon analysis (percent by weight, expressed as a decimal fraction) (Equation R-1).

- (7) Annual mass of carbonaceous materials (e.g., coal, coke) charged to each smelting furnace (tons) (Equation R-1).
- (8) Carbon content of the carbonaceous materials per furnace, from the carbon analysis (percent by weight, expressed as a decimal fraction) (Equation R-1).
- (9) Annual mass of each other material containing carbon, other than fuel, fed, charged, or otherwise introduced into the smelting furnace (tons) (Equation R-1).
- (10) Carbon content of each other material, from the carbon analysis results per furnace (percent by weight, expressed as a decimal fraction) (Equation R-1).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63792, Oct. 24, 2014]

## § 98.188 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart S—Lime Manufacturing

### § 98.190 Definition of the source category.

- (a) Lime manufacturing plants (LMPs) engage in the manufacture of a lime product by calcination of limestone, dolomite, shells or other calcareous substances as defined in 40 CFR 63.7081(a)(1).
- (b) This source category includes all LMPs unless the LMP is located at a kraft pulp mill, soda pulp mill, sulfite pulp mill, or only processes sludge containing calcium carbonate from water softening processes. The lime manufacturing source category consists of marketed and non-marketed lime manufacturing facilities.
- (c) Lime kilns at pulp and paper manufacturing facilities must report emissions under subpart AA of this part (Pulp and Paper Manufacturing).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71958, Nov. 29, 2013]

### § 98.191 Reporting threshold.

You must report GHG emissions under this subpart if your facility is a lime manufacturing plant as defined in § 98.190 and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.192 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from lime kilns.
- (b) CO<sub>2</sub> emissions from fuel combustion at lime kilns.
- (c) N<sub>2</sub>O and CH<sub>4</sub> emissions from fuel combustion at each lime kiln. You must report these emissions under 40 CFR part 98, subpart C (General Stationary Fuel Combustion Sources).
- (d) CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub> emissions from each stationary fuel combustion unit other than lime kilns. You must report these emissions under 40 CFR part 98, subpart C (General Stationary Fuel Combustion Sources).

- (e) CO<sub>2</sub> collected and transferred off site under 40 CFR part 98, following the requirements of subpart PP of this part (Suppliers of Carbon Dioxide (CO<sub>2</sub>)).

### § 98.193 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from all lime kilns combined using the procedure in paragraphs (a) and (b) of this section.

- (a) If all lime kilns meet the conditions specified in § 98.33(b)(4)(ii) or (iii), you must calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions from all lime kilns by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) If CEMS are not required to be used to determine CO<sub>2</sub> emissions from all lime kilns under paragraph (a) of this section, then you must calculate and report the process and combustion CO<sub>2</sub> emissions from the lime kilns by using the procedures in either paragraph (b)(1) or (b)(2) of this section.
- (1) Calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions from all lime kilns by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions from all lime kilns according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (2) Calculate and report process and combustion CO<sub>2</sub> emissions from all lime kilns separately using the procedures specified in paragraphs (b)(2)(i) through (viii) of this section.
- (i) You must calculate a monthly emission factor for each type of lime produced using Equation S-1 of this section. Calcium oxide and magnesium oxide content must be analyzed monthly for each lime product type that is produced:

$$EF_{LIME,i,n} = \left[ (SR_{CaO} \cdot CaO_{i,n}) + (SR_{MgO} \cdot MgO_{i,n}) \right] \cdot \frac{2000}{2205} \quad (\text{Eq. S-1})$$

Where:

$EF_{LIME,i,n}$  = Emission factor for lime type i, for month n (metric tons CO<sub>2</sub>/ton lime).

$SR_{CaO}$  = Stoichiometric ratio of CO<sub>2</sub> and CaO for calcium carbonate [see Table S-1 of this subpart] (metric tons CO<sub>2</sub>/metric tons CaO).

$SR_{MgO}$  = Stoichiometric ratio of CO<sub>2</sub> and MgO for magnesium carbonate (See Table S-1 of this subpart) (metric tons CO<sub>2</sub>/metric tons MgO).

$CaO_{i,n}$  = Calcium oxide content for lime type i, for month n, determined according to § 98.194(c) (metric tons CaO/metric ton lime).

$MgO_{i,n}$  = Magnesium oxide content for lime type i, for month n, determined according to § 98.194(c) (metric tons MgO/metric ton lime).

2000/2205 = Conversion factor for tons to metric tons.

- (ii) You must calculate a monthly emission factor for each type of calcined byproduct or waste sold (including lime kiln dust) using Equation S-2 of this section:

$$EF_{LKD,i,n} = \left[ (SR_{CaO} \cdot CaO_{LKD,i,n}) + (SR_{MgO} \cdot MgO_{LKD,i,n}) \right] \cdot \frac{2000}{2205} \quad (\text{Eq. S-2})$$

Where:

$EF_{LKD,i,n}$  = Emission factor for calcined lime byproduct/waste type i sold, for month n (metric tons CO<sub>2</sub>/ton lime byproduct).

$SR_{CaO}$  = Stoichiometric ratio of CO<sub>2</sub> and CaO for calcium carbonate (see Table S-1 of this subpart) (metric tons CO<sub>2</sub>/metric tons CaO).

$SR_{MgO}$  = Stoichiometric ratio of CO<sub>2</sub> and MgO for magnesium carbonate (See Table S-1 of this subpart) (metric tons CO<sub>2</sub>/metric tons MgO).

$CaO_{LKD,i,n}$  = Calcium oxide content for calcined lime byproduct/waste type i sold, for month n (metric tons CaO/metric ton lime).

$MgO_{LKD,i,n}$  = Magnesium oxide content for calcined lime byproduct/waste type i sold, for month n (metric tons MgO/metric ton lime).

2000/2205 = Conversion factor for tons to metric tons.

- (iii) You must calculate the annual CO<sub>2</sub> emissions from each type of calcined byproduct or waste that is not sold (including lime kiln dust and scrubber sludge) using Equation S-3 of this section:

$$E_{waste,i} = \left[ (SR_{CaO} \cdot CaO_{waste,i}) + (SR_{MgO} \cdot MgO_{waste,i}) \right] \cdot M_{waste,i} \cdot \frac{2000}{2205} \quad (\text{Eq. S-3})$$

Where:

$E_{waste,i}$  = Annual CO<sub>2</sub> emissions for calcined lime byproduct or waste type i that is not sold (metric tons CO<sub>2</sub>).

$SR_{CaO}$  = Stoichiometric ratio of CO<sub>2</sub> and CaO for calcium carbonate (see Table S-1 of this subpart) (metric tons CO<sub>2</sub>/metric tons CaO).

$SR_{MgO}$  = Stoichiometric ratio of CO<sub>2</sub> and MgO for magnesium carbonate (See Table S-1 of this subpart) (metric tons CO<sub>2</sub>/metric tons MgO).

$CaO_{waste,i}$  = Calcium oxide content for calcined lime byproduct or waste type i that is not sold (metric tons CaO/metric ton lime).

$MgO_{waste,i}$  = Magnesium oxide content for calcined lime byproduct or waste type i that is not sold (metric tons MgO/metric ton lime).

$M_{\text{waste},i}$  = Annual weight or mass of calcined byproducts or wastes for lime type  $i$  that is not sold (tons).

2000/2205 = Conversion factor for tons to metric tons.

- (iv) You must calculate annual  $\text{CO}_2$  process emissions for all lime kilns using Equation S-4 of this section:

$$E_{\text{CO}_2,\text{net}} = \sum_{i=1}^t \sum_{n=1}^{12} (EF_{\text{LIME},i,n} * M_{\text{LIME},i,n}) + \sum_{i=1}^b \sum_{n=1}^{12} (EF_{\text{LKD},i,n} * M_{\text{LKD},i,n}) + \sum_{i=1}^z E_{\text{waste},i} \quad (\text{Eq. S-4})$$

Where:

$E_{\text{CO}_2}$  = Annual  $\text{CO}_2$  process emissions from lime production from all lime kilns (metric tons/year).

$EF_{\text{LIME},i,n}$  = Emission factor for lime type  $i$  produced, in calendar month  $n$  (metric tons  $\text{CO}_2$ /ton lime) from Equation S-1 of this section.

$M_{\text{LIME},i,n}$  = Weight or mass of lime type  $i$  produced in calendar month  $n$  (tons).

$EF_{\text{LKD},i,n}$  = Emission factor of calcined byproducts or wastes sold for lime type  $i$  in calendar month  $n$ , (metric tons  $\text{CO}_2$ /ton byproduct or waste) from Equation S-2 of this section.

$M_{\text{LKD},i,n}$  = Monthly weight or mass of calcined byproducts or waste sold (such as lime kiln dust, LKD) for lime type  $i$  in calendar month  $n$  (tons).

$E_{\text{waste},i}$  = Annual  $\text{CO}_2$  emissions for calcined lime byproduct or waste type  $i$  that is not sold (metric tons  $\text{CO}_2$ ) from Equation S-3 of this section.

$t$  = Number of lime types produced

$b$  = Number of calcined byproducts or wastes that are sold.

$z$  = Number of calcined byproducts or wastes that are not sold.

- (v) Calculate and report under subpart C of this part (General Stationary Fuel Combustion Sources) the combustion  $\text{CO}_2$  emissions from each lime kiln according to the applicable requirements in subpart C.
- (vi) You must calculate an annual average emission factor for each type of lime product produced using Equation S-5 of this section.

$$EF_{\text{LIME},i,\text{avg}} = \frac{1}{n} \sum_{i=1}^n EF_{\text{LIME},i,n} \quad (\text{Eq. S-5})$$

Where:

$EF_{\text{LIME},i,\text{avg}}$  = Annual average emission factor for lime type  $i$ , (metric tons  $\text{CO}_2$ /ton lime)

$EF_{LIME,i,n}$  = Emission factor for lime type i, for calendar month n (metric tons CO<sub>2</sub>/ton lime) from Equation S-1 of this section.

n = Number of calendar months with calculated  $EF_{LIME,i,n}$  value used to calculate annual emission factor.

- (vii) You must calculate an annual average emission factor for each type of calcined byproduct/waste by lime type that is sold using Equation S-6 of this section.

$$EF_{LKD,i,avg} = \frac{1}{n} \sum_{i=1}^n EF_{LKD,i,n} \quad (\text{EQ. S-6})$$

Where:

$EF_{LKD,i,avg}$  = Annual average emission factor for calcined lime byproduct/waste type i sold (metric tons CO<sub>2</sub>/ton lime byproduct).

$EF_{LKD,i,n}$  = Emission factor for calcined lime byproduct/waste type i sold, for calendar month n (metric tons CO<sub>2</sub>/ton lime byproduct) from Equation S-2 of this section.

n = Number of calendar months with calculated  $EF_{LKD,i,n}$  value used to calculate annual emission factor.

- (viii) You must calculate an annual average result of chemical composition analysis of each type of lime product produced and calcined byproduct/waste sold using Equations S-7 through S-10 of this section.

$$CaO_{i,avg} = \frac{1}{n} \sum_{i=1}^n CaO_{i,n} \quad (\text{Eq. S-7})$$

Where

$CaO_{i,avg}$  = Annual average calcium oxide content for lime type i (metric tons CaO/metric ton lime).

$CaO_{i,n}$  = Calcium oxide content for lime type i, for calendar month n, determined according to § 98.194(c) for Equation S-1 of this section (metric tons CaO/metric ton lime).

n = Number of calendar months with calculated  $CaO_{i,n}$  value used to calculate annual average calcium oxide content.

$$MgO_{i,avg} = \frac{1}{n} \sum_{i=1}^n MgO_{i,n} \quad (\text{Eq. S-8})$$

Where:

$MgO_{i,avg}$  = Annual average magnesium oxide content for lime type i (metric tons MgO/metric ton lime).

$MgO_{i,n}$  = Magnesium oxide content for lime type i, for calendar month n, determined according to § 98.194(c) for Equation S-1 of this section (metric tons MgO/metric ton lime).

n = Number of calendar months with calculated  $MgO_{i,n}$  value used to calculate annual average magnesium oxide content.

$$CaO_{LKD,i,avg} = \frac{1}{n} \sum_{i=1}^n CaO_{LKD,i,n} \quad (\text{Eq. S-9})$$

Where:

$CaO_{LKD,i,avg}$  = Annual average calcium oxide content for calcined lime byproduct/waste type i sold (metric tons CaO/metric ton lime).

$CaO_{LKD,i,n}$  = Calcium oxide content for calcined lime byproduct/waste type i sold, for calendar month n, determined according to § 98.194(c) for Equation S-2 of this section (metric tons CaO/metric ton lime).

n = Number of calendar months with calculated  $CaO_{LKD,i,n}$  value used to calculate annual average calcium oxide content.

$$MgO_{LKD,i,avg} = \frac{1}{n} \sum_{i=1}^n MgO_{LKD,i,n} \quad (\text{Eq. S-10})$$

Where:

$MgO_{LKD,i,avg}$  = Annual average magnesium oxide content for calcined lime byproduct/waste type i sold (metric tons MgO/metric ton lime).

$MgO_{LKD,i,n}$  = Magnesium oxide content for calcined lime byproduct/waste type i sold, for calendar month n, determined according to § 98.194(c) for Equation S-2 of this section (metric tons MgO/metric ton lime).

n = Number of calendar months with calculated  $MgO_{LKD,i,n}$  value used to calculate annual average magnesium oxide content.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66464, Oct. 28, 2010; 78 FR 71958, Nov. 29, 2013; 81 FR 89258, Dec. 9, 2016; 89 FR 31928, Apr. 25, 2024]

### § 98.194 Monitoring and QA/QC requirements.

- (a) You must determine the total quantity of each type of lime product that is produced and each calcined byproduct or waste (such as lime kiln dust) that is sold. The quantities of each should be directly measured monthly with the same plant instruments used for accounting purposes, including but not limited to, calibrated weigh feeders, rail or truck scales, and barge measurements. The direct measurements of each lime product shall be reconciled annually with the difference in the beginning of and end of year inventories for these products, when measurements represent lime sold.
- (b) You must determine the annual quantity of each calcined byproduct or waste generated that is not sold by either direct measurement using the same instruments identified in paragraph (a) of this section or by using a calcined byproduct or waste generation rate.
- (c) You must determine the chemical composition (percent total CaO and percent total MgO) of each type of lime product that is produced and each type of calcined byproduct or waste sold according to paragraph (c)(1) or (2) of this section. You must determine the chemical composition of each type of lime product that is produced and each type of calcined byproduct or waste sold on a monthly basis. You must determine the chemical composition for each type of calcined byproduct or waste that is not sold on an annual basis.



- (1) ASTM C25-06 Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime (incorporated by reference—see § 98.7).
- (2) The National Lime Association's CO<sub>2</sub> Emissions Calculation Protocol for the Lime Industry English Units Version, February 5, 2008 Revision—National Lime Association (incorporated by reference—see § 98.7).
- (d) You must use the analysis of calcium oxide and magnesium oxide content of each lime product that is produced and that is collected during the same month as the production data in monthly calculations.
- (e) You must follow the quality assurance/quality control procedures (including documentation) in National Lime Association's CO<sub>2</sub> Emissions Calculation Protocol for the Lime Industry English Units Version, February 5, 2008 Revision—National Lime Association (incorporated by reference—see § 98.7).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66465, Oct. 28, 2010; 78 FR 71958, Nov. 29, 2013]

### § 98.195 Procedures for estimating missing data.

For the procedure in § 98.193(b)(1), a complete record of all measured parameters used in the GHG emissions calculations is required (e.g., oxide content, quantity of lime products, etc.). Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in paragraphs (a) or (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) For each missing value of the quantity of lime produced (by lime type), and quantity of calcined byproduct or waste produced and sold, the substitute data value shall be the best available estimate based on all available process data or data used for accounting purposes.
- (b) For missing values related to the CaO and MgO content, you must conduct a new composition test according to the standard methods in § 98.194 (c)(1) or (c)(2).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66465, Oct. 28, 2010; 78 FR 71959, Nov. 29, 2013]

### § 98.196 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) or (b) of this section, as applicable.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required by § 98.36 and the information listed in paragraphs (a)(1) through (14) of this section.
  - (1) Method used to determine the quantity of lime that is produced and quantity of lime that is sold.
  - (2) Method used to determine the quantity of calcined lime byproduct or waste sold.
  - (3) Beginning and end of year inventories for each lime product that is produced, by type.
  - (4) Beginning and end of year inventories for calcined lime byproducts or wastes sold, by type.
  - (5) Annual amount of calcined lime byproduct or waste sold, by type (tons).
  - (6) Annual amount of lime product sold, by type (tons).

- (7) Annual amount of calcined lime byproduct or waste that is not sold, by type (tons).
  - (8) Annual amount of lime product not sold, by type (tons).
  - (9) Annual arithmetic average of calcium oxide content for each type of lime product produced (metric tons CaO/metric ton lime).
  - (10) Annual arithmetic average of magnesium oxide content for each type of lime product produced (metric tons MgO/metric ton lime).
  - (11) Annual arithmetic average of calcium oxide content for each type of calcined lime byproduct/waste sold (metric tons CaO/metric ton lime).
  - (12) Annual arithmetic average of magnesium oxide content for each type of calcined lime byproduct/waste sold (metric tons MgO/metric ton lime).
  - (13) Annual arithmetic average of calcium oxide content for each type of calcined lime byproduct/waste not sold (metric tons CaO/metric ton lime).
  - (14) Annual arithmetic average of magnesium oxide content for each type of calcined lime byproduct/waste not sold (metric tons MgO/metric ton lime)
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must report the information listed in paragraphs (b)(1) through (23) of this section.
- (1) Annual CO<sub>2</sub> process emissions from all lime kilns combined (metric tons).
  - (2)-(3) [Reserved]
  - (4) Standard method used (ASTM or NLA testing method) to determine chemical compositions of each lime type produced and each calcined lime byproduct or waste type.
  - (5)-(6) [Reserved]
  - (7) Method used to determine the quantity of lime produced and/or lime sold.
  - (8) [Reserved]
  - (9) Method used to determine the quantity of calcined lime byproduct or waste sold.
  - (10)-(12) [Reserved]
  - (13) Beginning and end of year inventories for each lime product that is produced.
  - (14) Beginning and end of year inventories for calcined lime byproducts or wastes sold.
  - (15) Annual lime production capacity (tons) per facility.
  - (16) Number of times in the reporting year that missing data procedures were followed to measure lime production (months) or the chemical composition of lime products sold (months).
  - (17) Indicate whether CO<sub>2</sub> was captured and used on-site (e.g., for use in a purification process, the manufacture of another product). If CO<sub>2</sub> was captured and used on-site, provide the information in paragraphs (b)(17)(i) and (ii) of this section.
    - (i) The annual amount of CO<sub>2</sub> captured for use in all on-site processes.
    - (ii) The method used to determine the amount of CO<sub>2</sub> captured.

- (18) Annual quantity (tons) of lime product sold, by type.
- (19) Annual average emission factors for each lime product type produced.
- (20) Annual average emission factors for each calcined byproduct/waste by lime type that is sold.
- (21) Annual average results of chemical composition analysis of each type of lime product produced and calcined byproduct/waste sold.
- (22) Annual average results of chemical composition analysis of all lime byproducts or wastes not sold.
- (23) Annual quantity (tons) of all lime byproducts or wastes not sold.

[75 FR 66465, Oct. 28, 2010, as amended at 78 FR 71959, Nov. 29, 2013; 79 FR 63792, Oct. 24, 2014; 81 FR 89259, Dec. 9, 2016; 89 FR 31928, Apr. 25, 2024]

### § 98.197 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (c) of this section.

- (a) Annual operating hours in calendar year.
- (b) Records of all analyses (e.g. chemical composition of lime products, by type) and calculations conducted.
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) through (9) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) through (9) of this section.
  - (1) Monthly calcium oxide content for each lime type, determined according to § 98.194(c) (metric tons CaO/metric ton lime) (Equation S-1 of § 98.193).
  - (2) Monthly magnesium oxide content for each lime type, determined according to § 98.194(c) (metric tons MgO/metric ton lime) (Equation S-1).
  - (3) Monthly calcium oxide content for each calcined lime byproduct or waste type sold (metric tons CaO/metric ton lime) (Equation S-2 of § 98.193).
  - (4) Monthly magnesium oxide content for each calcined lime byproduct or waste type sold (metric tons MgO/metric ton lime) (Equation S-2).
  - (5) Calcium oxide content for each calcined lime byproduct or waste type that is not sold (metric tons CaO/metric ton lime) (Equation S-3 of § 98.193).
  - (6) Magnesium oxide content for each calcined lime byproduct or waste type that is not sold (metric tons MgO/metric ton lime) (Equation S-3).
  - (7) Annual weight or mass of calcined byproducts or wastes for lime type that is not sold (tons) (Equation S-3).
  - (8) Monthly weight or mass of each lime type produced (tons) (Equation S-4 of § 98.193).
  - (9) Monthly weight or mass of each calcined byproducts or wastes sold (tons) (Equation S-4).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63792, Oct. 24, 2014]

§ 98.198 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

Table S-1 to Subpart S of Part 98—Basic Parameters for the Calculation of Emission Factors for Lime Production

| Variable          | Stoichiometric ratio |
|-------------------|----------------------|
| SR <sub>CaO</sub> | 0.7848               |
| SR <sub>MgO</sub> | 1.0918               |

Subpart T—Magnesium Production

Source: 75 FR 39761, July 12, 2010, unless otherwise noted.

§ 98.200 Definition of source category.

The magnesium production and processing source category consists of the following processes:

- (a) Any process in which magnesium metal is produced through smelting (including electrolytic smelting), refining, or remelting operations.
- (b) Any process in which molten magnesium is used in alloying, casting, drawing, extruding, forming, or rolling operations.

§ 98.201 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a magnesium production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

§ 98.202 GHGs to report.

- (a) You must report emissions of the following gases in metric tons per year resulting from their use as cover gases or carrier gases in magnesium production or processing:
  - (1) Sulfur hexafluoride (SF<sub>6</sub>).
  - (2) HFC-134a.
  - (3) The fluorinated ketone, FK 5-1-12.
  - (4) Carbon dioxide (CO<sub>2</sub>).
  - (5) Any other GHGs (as defined in § 98.6).
- (b) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub> emissions from each combustion unit by following the requirements of subpart C.

## § 98.203 Calculating GHG emissions.

- (a) Calculate the mass of each GHG emitted from magnesium production or processing over the calendar year using either Equation T-1 or Equation T-2 of this section, as appropriate. Both of these equations equate emissions of cover gases or carrier gases to consumption of cover gases or carrier gases.
- (1) To estimate emissions of cover gases or carrier gases by monitoring changes in container masses and inventories, emissions of each cover gas or carrier gas shall be estimated using Equation T-1 of this section:

$$E_x = (I_{B,x} - I_{E,x} + A_x - D_x) \cdot 0.001 \quad (\text{Eq. T-1})$$

Where:

$E_x$  = Emissions of each cover gas or carrier gas, X, in metric tons over the reporting year.

$I_{B,x}$  = Inventory of each cover gas or carrier gas stored in cylinders or other containers at the beginning of the year, including heels, in kg.

$I_{E,x}$  = Inventory of each cover gas or carrier gas stored in cylinders or other containers at the end of the year, including heels, in kg.

$A_x$  = Acquisitions of each cover gas or carrier gas during the year through purchases or other transactions, including heels in cylinders or other containers returned to the magnesium production or processing facility, in kg.

$D_x$  = Disbursements of each cover gas or carrier gas to sources and locations outside the facility through sales or other transactions during the year, including heels in cylinders or other containers returned by the magnesium production or processing facility to the gas supplier, in kg.

0.001 = Conversion factor from kg to metric tons

X = Each cover gas or carrier gas that is a GHG.

- (2) To estimate emissions of cover gases or carrier gases by monitoring changes in the masses of individual containers as their contents are used, emissions of each cover gas or carrier gas shall be estimated using Equation T-2 of this section:

$$E_{GHG} = \sum_{p=1}^n Q_p \cdot 0.001 \quad (\text{Eq. T-2})$$

Where:

$E_{GHG}$  = Emissions of each cover gas or carrier gas, X, over the reporting year (metric tons).

$Q_p$  = The mass of the cover or carrier gas consumed (kg) over the container-use period p, from Equation T-3 of this section.

n = The number of container-use periods in the year.

0.001 = Conversion factor from kg to metric tons.

X = Each cover gas or carrier gas that is a GHG.

- (b) For purposes of Equation T-2 of this section, the mass of the cover gas used over the period p for an individual container shall be estimated by using Equation T-3 of this section:

$$Q_p = M_B - M_E \quad (\text{Eq. T-3})$$

Where:

$Q_p$  = The mass of the cover or carrier gas consumed (kg) over the container-use period p (e.g., one month).

$M_B$  = The mass of the container's contents (kg) at the beginning of period p.

$M_E$  = The mass of the container's contents (kg) at the end of period p.

- (c) If a facility has mass flow controllers (MFC) and the capacity to track and record MFC measurements to estimate total gas usage, the mass of each cover or carrier gas monitored may be used as the mass of cover or carrier gas consumed ( $Q_p$ ), in kg for period p in Equation T-2 of this section.

#### § 98.204 Monitoring and QA/QC requirements.

- (a) For calendar year 2011 monitoring, the facility may submit a request to the Administrator to use one or more best available monitoring methods as listed in § 98.3(d)(1)(i) through (iv). The request must be submitted no later than October 12, 2010 and must contain the information in § 98.3(d)(2)(ii). To obtain approval, the request must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by January 1, 2011. The use of best available monitoring methods will not be approved beyond December 31, 2011.
- (b) Emissions (consumption) of cover gases and carrier gases may be estimated by monitoring the changes in container weights and inventories using Equation T-1 of this subpart, by monitoring the changes in individual container weights as the contents of each container are used using Equations T-2 and T-3 of this subpart, or by monitoring the mass flow of the pure cover gas or carrier gas into the gas distribution system. Emissions must be estimated at least annually.
- (c) When estimating emissions by monitoring the mass flow of the pure cover gas or carrier gas into the gas distribution system, you must use gas flow meters, or mass flow controllers, with an accuracy of 1 percent of full scale or better.
- (d) When estimating emissions using Equation T-1 of this subpart, you must ensure that all the quantities required by Equation T-1 of this subpart have been measured using scales or load cells with an accuracy of 1 percent of full scale or better, accounting for the tare weights of the containers. You may accept gas masses or weights provided by the gas supplier e.g., for the contents of containers containing new gas or for the heels remaining in containers returned to the gas supplier) if the supplier provides documentation verifying that accuracy standards are met; however you remain responsible for the accuracy of these masses or weights under this subpart.

- (e) When estimating emissions using Equations T-2 and T-3 of this subpart, you must monitor and record container identities and masses as follows:
  - (1) Track the identities and masses of containers leaving and entering storage with check-out and check-in sheets and procedures. The masses of cylinders returning to storage shall be measured immediately before the cylinders are put back into storage.
  - (2) Ensure that all the quantities required by Equations T-2 and T-3 of this subpart have been measured using scales or load cells with an accuracy of 1 percent of full scale or better, accounting for the tare weights of the containers. You may accept gas masses or weights provided by the gas supplier e.g., for the contents of cylinders containing new gas or for the heels remaining in cylinders returned to the gas supplier) if the supplier provides documentation verifying that accuracy standards are met; however, you remain responsible for the accuracy of these masses or weights under this subpart.
- (f) All flowmeters, scales, and load cells used to measure quantities that are to be reported under this subpart shall be calibrated using calibration procedures specified by the flowmeter, scale, or load cell manufacturer. Calibration shall be performed prior to the first reporting year. After the initial calibration, recalibration shall be performed at the minimum frequency specified by the manufacturer.

### § 98.205 Procedures for estimating missing data.

- (a) A complete record of all measured parameters used in the GHG emission calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter will be used in the calculations as specified in paragraph (b) of this section.
- (b) Replace missing data on the emissions of cover or carrier gases by multiplying magnesium production during the missing data period by the average cover or carrier gas usage rate from the most recent period when operating conditions were similar to those for the period for which the data are missing. Calculate the usage rate for each cover or carrier gas using Equation T-4 of this section:

$$R_{\text{GHG}} = C_{\text{GHG}} / \text{Mg} \cdot 0.001 \quad (\text{Eq. T-4})$$

Where:

$R_{\text{GHG}}$  = The usage rate for a particular cover or carrier gas over the period of comparable operation (metric tons gas/metric ton Mg).

$C_{\text{GHG}}$  = The consumption of that cover or carrier gas over the period of comparable operation (kg).

Mg = The magnesium produced or fed into the process over the period of comparable operation (metric tons).

0.001 = Conversion factor from kg to metric tons.

- (c) If the precise before and after weights are not available, it should be assumed that the container was emptied in the process (i.e., quantity purchased should be used, less heel).

### § 98.206 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must include the following information at the facility level:

- (a) Emissions of each cover or carrier gas in metric tons.
- (b) Types of production processes at the facility (e.g., primary, secondary, die casting).
- (c) Amount of magnesium produced or processed in metric tons for each process type. This includes the output of primary and secondary magnesium production processes and the input to magnesium casting processes.
- (d) Cover and carrier gas flow rate (e.g., standard cubic feet per minute) for each production unit and composition in percent by volume.
- (e) For any missing data, you must report the length of time the data were missing for each cover gas or carrier gas, the method used to estimate emissions in their absence, and the quantity of emissions thereby estimated.
- (f) The annual cover gas usage rate for the facility for each cover gas, excluding the carrier gas (kg gas/metric ton Mg).
- (g) If applicable, an explanation of any change greater than 30 percent in the facility's cover gas usage rate (e.g., installation of new melt protection technology or leak discovered in the cover gas delivery system that resulted in increased emissions).
- (h) A description of any new melt protection technologies adopted to account for reduced or increased GHG emissions in any given year.

### § 98.207 Records that must be retained.

In addition to the records specified in § 98.3(g), you must retain the following information at the facility level:

- (a) Check-out and weigh-in sheets and procedures for gas cylinders.
- (b) Accuracy certifications and calibration records for scales including the method or manufacturer's specification used for calibration.
- (c) Residual gas amounts (heel) in cylinders sent back to suppliers.
- (d) Records, including invoices, for gas purchases, sales, and disbursements for all GHGs.

### § 98.208 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part. Additionally, some sector-specific definitions are provided below:

**Carrier gas** means the gas with which cover gas is mixed to transport and dilute the cover gas thus maximizing its efficient use. Carrier gases typically include CO<sub>2</sub>, N<sub>2</sub>, and/or dry air.

**Cover gas** means SF<sub>6</sub>, HFC-134a, fluorinated ketone (FK 5-1-12) or other gas used to protect the surface of molten magnesium from rapid oxidation and burning in the presence of air. The molten magnesium may be the surface of a casting or ingot production operation or the surface of a crucible of molten magnesium that feeds a casting operation.

## Subpart U—Miscellaneous Uses of Carbonate



### § 98.210 Definition of the source category.

- (a) This source category includes any equipment that uses carbonates listed in Table U-1 in manufacturing processes that emit carbon dioxide. Table U-1 includes the following carbonates: limestone, dolomite, ankerite, magnesite, siderite, rhodochrosite, or sodium carbonate. Facilities are considered to emit CO<sub>2</sub> if they consume at least 2,000 tons per year of carbonates heated to a temperature sufficient to allow the calcination reaction to occur.
- (b) This source category does not include equipment that uses carbonates or carbonate containing minerals that are consumed in the production of cement, glass, ferroalloys, iron and steel, lead, lime, phosphoric acid, pulp and paper, soda ash, sodium bicarbonate, sodium hydroxide, zinc, or ceramics.
- (c) This source category does not include carbonates used in sorbent technology used to control emissions from stationary fuel combustion equipment. Emissions from carbonates used in sorbent technology are reported under 40 CFR 98, subpart C (Stationary Fuel Combustion Sources).

[74 FR 56374, Oct. 30, 2009, as amended at 89 FR 31929, Apr. 25, 2024]

### § 98.211 Reporting threshold.

You must report GHG emissions from miscellaneous uses of carbonate if your facility uses carbonates as defined in § 98.210 of this subpart and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.212 GHGs to report.

You must report CO<sub>2</sub> process emissions from all miscellaneous carbonate use at your facility as specified in this subpart.

### § 98.213 Calculating GHG emissions.

You must determine CO<sub>2</sub> process emissions from carbonate use in accordance with the procedures specified in either paragraphs (a) or (b) of this section.

- (a) Calculate the process emissions of CO<sub>2</sub> using calcination fractions with Equation U-1 of this section.

$$E_{\text{CO}_2} = \sum_{i=1}^n M_i \cdot EF_i \cdot F_i \cdot \frac{2000}{2205} \quad (\text{Eq. U-1})$$

Where:

$E_{\text{CO}_2}$  = Annual CO<sub>2</sub> mass emissions from consumption of carbonates (metric tons).

$M_i$  = Annual mass of carbonate type  $i$  consumed (tons).

$EF_i$  = Emission factor for the carbonate type  $i$ , as specified in Table U-1 to this subpart, metric tons CO<sub>2</sub>/metric ton carbonate consumed.

$F_i$  = Fraction calcination achieved for each particular carbonate type  $i$  (decimal fraction). As an alternative to measuring the calcination fraction, a value of 1.0 can be used.

n = Number of carbonate types.

2000/2205 = Conversion factor to convert tons to metric tons.

- (b) Calculate the process emissions of CO<sub>2</sub> using actual mass of output carbonates with Equation U-2 of this section.

$$E_{\text{CO}_2} = \left[ \sum_{k=1}^m (M_k \cdot EF_k) - \sum_{j=1}^n (M_j \cdot EF_j) \right] \cdot \frac{2000}{2205} \quad (\text{Eq. U-2})$$

Where:

E<sub>CO2</sub> = Annual CO<sub>2</sub> mass emissions from consumption of carbonates (metric tons).

M<sub>k</sub> = Annual mass of input carbonate type k (tons).

EF<sub>k</sub> = Emission factor for the carbonate type k, as specified in Table U-1 of this subpart (metric tons CO<sub>2</sub>/metric ton carbonate input).

M<sub>j</sub> = Annual mass of output carbonate type j (tons).

EF<sub>j</sub> = Emission factor for the output carbonate type j, as specified in Table U-1 of this subpart (metric tons CO<sub>2</sub>/metric ton carbonate input).

m = Number of input carbonate types.

n = Number of output carbonate types.

### § 98.214 Monitoring and QA/QC requirements.

- (a) The annual mass of carbonate consumed (for Equation U-1 of this subpart) or carbonate inputs (for Equation U-2 of this subpart) must be determined annually from monthly measurements using the same plant instruments used for accounting purposes including purchase records or direct measurement, such as weigh hoppers or weigh belt feeders.
- (b) The annual mass of carbonate outputs (for Equation U-2 of this subpart) must be determined annually from monthly measurements using the same plant instruments used for accounting purposes including purchase records or direct measurement, such as weigh hoppers or belt weigh feeders.
- (c) If you follow the procedures of § 98.213(a), as an alternative to assuming a calcination fraction of 1.0, you can determine on an annual basis the calcination fraction for each carbonate consumed based on sampling and chemical analysis using a suitable method such as using an x-ray fluorescence standard method or other enhanced industry consensus standard method published by an industry consensus standard organization (e.g., ASTM, ASME, etc.).

### § 98.215 Procedures for estimating missing data.

- (a) A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in paragraph (b) of this section. You must document and keep records of the procedures used for all such estimates.
- (b) For each missing value of monthly carbonate consumed, monthly carbonate output, or monthly carbonate input, the substitute data value must be the best available estimate based on the all available process data or data used for accounting purposes.

### § 98.216 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (g) of this section at the facility level, as applicable.

- (a) Annual CO<sub>2</sub> emissions from miscellaneous carbonate use (metric tons).
- (b) [Reserved]
- (c) Measurement method used to determine the mass of carbonate.
- (d) Method used to calculate emissions.
- (e) If you followed the calculation method of § 98.213(a), you must report the information in paragraphs (e)(1) through (3) of this section.
  - (1)-(2) [Reserved]
  - (3) If you determined the calcination fraction, indicate which standard method was used.
- (f) [Reserved]
- (g) Number of times in the reporting year that missing data procedures were followed to measure carbonate consumption, carbonate input or carbonate output (months).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63792, Oct. 24, 2014; 81 FR 89259, Dec. 9, 2016]

### § 98.217 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (e) of this section:

- (a) Monthly carbonate consumption (by carbonate type in tons).
- (b) You must document the procedures used to ensure the accuracy of the monthly measurements of carbonate consumption, carbonate input or carbonate output including, but not limited to, calibration of weighing equipment and other measurement devices.
- (c) Records of all analyses conducted to meet the requirements of this rule.
- (d) Records of all calculations conducted.

- (e) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (e)(1) through (4) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (e)(1) through (4) of this section.
- (1) Fraction calcination achieved for each particular carbonate type. As an alternative to measuring the calcination fraction, a value of 1.0 can be used (decimal fraction) (Equation U-1 of § 98.213).
- (2) Annual mass of each carbonate type consumed (tons) (Equation U-1).
- (3) Annual mass of each input carbonate type (tons) (Equation U-2 of § 98.213).
- (4) Annual mass of each output carbonate type (tons) (Equation U-2).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63793, Oct. 24, 2014]

§ 98.218 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

Table U-1 to Subpart U of Part 98—CO<sub>2</sub> Emission Factors for Common Carbonates

| Mineral name—carbonate                                    | CO <sub>2</sub> emission factor<br>(tons CO <sub>2</sub> /ton carbonate) |
|-----------------------------------------------------------|--------------------------------------------------------------------------|
| Limestone—CaCO <sub>3</sub>                               | 0.43971                                                                  |
| Magnesite—MgCO <sub>3</sub>                               | 0.52197                                                                  |
| Dolomite—CaMg(CO <sub>3</sub> ) <sub>2</sub>              | 0.47732                                                                  |
| Siderite—FeCO <sub>3</sub>                                | 0.37987                                                                  |
| Ankerite—Ca(Fe, Mg, Mn)(CO <sub>3</sub> ) <sub>2</sub>    | 0.47572                                                                  |
| Rhodochrosite—MnCO <sub>3</sub>                           | 0.38286                                                                  |
| Sodium Carbonate/Soda Ash—Na <sub>2</sub> CO <sub>3</sub> | 0.41492                                                                  |

Subpart V—Nitric Acid Production

§ 98.220 Definition of source category.

This source category includes a nitric acid production facility using one or more trains to produce weak nitric acid (30 to 70 percent in strength). Starting with reporting year 2018, this source category includes all nitric acid production facilities using one or more trains to produce nitric acid (any strength). A nitric acid train produces nitric acid through the catalytic oxidation of ammonia.

[81 FR 89259, Dec. 9, 2016]

## § 98.221 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a nitric acid train and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

## § 98.222 GHGs to report.

- (a) You must report N<sub>2</sub>O process emissions from each nitric acid train as required by this subpart.
- (b) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit by following the requirements of subpart C.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71959, Nov. 29, 2013]

## § 98.223 Calculating GHG emissions.

- (a) You must determine annual N<sub>2</sub>O process emissions from each nitric acid train according to paragraphs (a)(1) or (a)(2) of this section.
  - (1) Use a site-specific emission factor and production data according to paragraphs (b) through (i) of this section.
  - (2) Request Administrator approval for an alternative method of determining N<sub>2</sub>O emissions according to paragraphs (a)(2)(i) through (iv) of this section.
    - (i) If you received Administrator approval for an alternative method of determining N<sub>2</sub>O emissions in the previous reporting year and your methodology is unchanged, your alternative method is automatically approved for the next reporting year.
    - (ii) You must notify the EPA of your use of a previously approved alternative method in your annual report.
    - (iii) Otherwise, if you have not received Administrator approval for an alternative method of determining N<sub>2</sub>O emissions in a prior reporting year or your methodology has changed, you must submit the request within the first 30 days of each subsequent reporting year.
    - (iv) If the Administrator does not approve your requested alternative method within 150 days of the end of the reporting year, you must determine the N<sub>2</sub>O emissions for the current reporting period using the procedures specified in paragraph (a)(1) of this section.
- (b) You must conduct an annual performance test for each nitric acid train according to paragraphs (b)(1) through (3) of this section.
  - (1) You must conduct the performance test at the absorber tail gas vent, referred to as the test point, for each nitric acid train according to § 98.224(b) through (f). If multiple nitric acid trains exhaust to a common abatement technology and/or emission point, you must sample each process in the ducts before the emissions are combined, sample each process when only one process is operating, or sample the combined emissions when multiple processes are operating and base the site-specific emission factor on the combined production rate of the multiple nitric acid trains.
  - (2) You must conduct the performance test under normal process operating conditions.
  - (3) You must measure the production rate during the performance test and calculate the production rate for the test period in tons (100 percent acid basis) per hour.

- (c) Using the results of the performance test in paragraph (b) of this section, you must calculate an average site-specific emission factor for each nitric acid train "t" according to Equation V-1 of this section:

$$EF_{N_2O} = \frac{\sum_{i=1}^n \frac{C_{N_2O} \cdot 1.14 \times 10^{-7} \cdot Q}{P}}{n} \quad (\text{Eq. V-1})$$

where:

$EF_{N_2O}$  = Average site-specific  $N_2O$  emissions factor for nitric acid train "t" (lb  $N_2O$ /ton nitric acid produced, 100 percent acid basis).

$C_{N_2O}$  =  $N_2O$  concentration for each test run during the performance test (ppm  $N_2O$ ).

$1.14 \times 10^{-7}$  = Conversion factor (lb/dscf-ppm  $N_2O$ ).

$Q$  = Volumetric flow rate of effluent gas for each test run during the performance test (dscf/hr).

$P$  = Production rate for each test run during the performance test (tons nitric acid produced per hour, 100 percent acid basis).

$n$  = Number of test runs.

- (d) If nitric acid train "t" exhausts to any  $N_2O$  abatement technology "N", you must determine the destruction efficiency for each  $N_2O$  abatement technology "N" according to paragraphs (d)(1), (2), or (3) of this section.

- (1) Use the manufacturer's specified destruction efficiency.
- (2) Estimate the destruction efficiency through process knowledge. Examples of information that could constitute process knowledge include calculations based on material balances, process stoichiometry, or previous test results provided the results are still relevant to the current vent stream conditions. You must document how process knowledge (if applicable) was used to determine the destruction efficiency.
- (3) Calculate the destruction efficiency by conducting an additional performance test on the emissions stream following the  $N_2O$  abatement technology.

- (e) If nitric acid train "t" exhausts to any  $N_2O$  abatement technology "N", you must determine the annual amount of nitric acid produced on nitric acid train "t" while  $N_2O$  abatement technology "N" is operating according to § 98.224(f). Then you must calculate the abatement utilization factor for each  $N_2O$  abatement technology "N" for each nitric acid train "t" according to Equation V-2 of this section.

$$AF_{i,N} = \frac{P_{i,N}}{P_i} \quad (\text{Eq. V-2})$$

where:

$AF_{t,N}$  = Abatement utilization factor of  $N_2O$  abatement technology "N" at nitric acid train "t" (fraction of annual production that abatement technology is operating).

$P_t$  = Total annual nitric acid production from nitric acid train "t" (ton acid produced, 100 percent acid basis).

$P_{t,N}$  = Annual nitric acid production from nitric acid train "t" during which  $N_2O$  abatement technology "N" was operational (ton acid produced, 100 percent acid basis).

(f) [Reserved]

(g) You must calculate  $N_2O$  emissions for each nitric acid train "t" according to paragraph (g)(1), (g)(2), (g)(3), or (g)(4) of this section.

(1) If nitric acid train "t" exhausts to one  $N_2O$  abatement technology "N" after the test point, you must use the emissions factor (determined in Equation V-1 of this section), the destruction efficiency (determined in paragraph (d) of this section), the annual nitric acid production (determined in paragraph (i) of this section), and the abatement utilization factor (determined in paragraph (e) of this section) according to Equation V-3a of this section:

$$E_{N_2O} = \frac{EF_{N_2O,t} \cdot P_t}{2205} \cdot (1 - (DF \cdot AF)) \quad (\text{Eq. V-3a})$$

where:

$E_{N_2O}$  = Annual  $N_2O$  mass emissions from nitric acid train "t" according to this Equation V-3a (metric tons).

$EF_{N_2O,t}$  = Average site-specific  $N_2O$  emissions factor for nitric acid train "t" (lb  $N_2O$ /ton acid produced, 100 percent acid basis).

$P_t$  = Annual nitric acid production from nitric acid train "t" (ton acid produced, 100 percent acid basis).

DF = Destruction efficiency of  $N_2O$  abatement technology N that is used on nitric acid train "t" (decimal fraction of  $N_2O$  removed from vent stream).

AF = Abatement utilization factor of  $N_2O$  abatement technology "N" for nitric acid train "t" (decimal fraction of annual production during which abatement technology is operating).

2205 = Conversion factor (lb/metric ton).

(2) If multiple  $N_2O$  abatement technologies are located in series after your test point, you must use the emissions factor (determined in Equation V-1 of this section), the destruction efficiency (determined in paragraph (d) of this section), the annual nitric acid production (determined in paragraph (i) of this section), and the abatement utilization factor (determined in paragraph (e) of this section), according to Equation V-3b of this section:

$$E_{N_2O} = \frac{EF_{N_2O,t} \cdot P_t}{2205} \cdot (1 - (DF_1 \cdot AF_1)) \cdot (1 - (DF_2 \cdot AF_2)) \cdot \dots \cdot (1 - (DF_N \cdot AF_N)) \quad (\text{Eq. V-3b})$$

where:

$E_{N_2O,t}$  = Annual  $N_2O$  mass emissions from nitric acid train "t" according to this Equation V-3b (metric tons).

$EF_{N_2O,t}$  =  $N_2O$  emissions factor for nitric acid train "t" (lb  $N_2O$ /ton nitric acid produced).

$P_t$  = Annual nitric acid produced from nitric acid train "t" (ton acid produced, 100 percent acid basis).

$DF_1$  = Destruction efficiency of  $N_2O$  abatement technology 1 (decimal fraction of  $N_2O$  removed from vent stream).

$AF_1$  = Abatement utilization factor of  $N_2O$  abatement technology 1 (decimal fraction of time that abatement technology 1 is operating).

$DF_2$  = Destruction efficiency of  $N_2O$  abatement technology 2 (decimal fraction of  $N_2O$  removed from vent stream).

$AF_2$  = Abatement utilization factor of  $N_2O$  abatement technology 2 (decimal fraction of time that abatement technology 2 is operating).

$DF_N$  = Destruction efficiency of  $N_2O$  abatement technology N (decimal fraction of  $N_2O$  removed from vent stream).

$AF_N$  = Abatement utilization factor of  $N_2O$  abatement technology N (decimal fraction of time that abatement technology N is operating).

2205 = Conversion factor (lb/metric ton).

N = Number of different  $N_2O$  abatement technologies.

- (3) If multiple  $N_2O$  abatement technologies are located in parallel after your test point, you must use the emissions factor (determined in Equation V-1 of this section), the destruction efficiency (determined in paragraph (d) of this section), the annual nitric acid production (determined in paragraph (i) of this section), and the abatement utilization factor (determined in paragraph (e) of this section), according to Equation V-3c of this section:

$$E_{N_2O,t} = \frac{EF_{N_2O,t} \cdot P_t}{2205} \cdot \sum_1^N \left( (1 - (DF_N \cdot AF_N)) \cdot FC_N \right) \quad (\text{Eq. V-3c})$$

where:

$E_{N_2O,t}$  = Annual  $N_2O$  mass emissions from nitric acid train "t" according to this Equation V-3c (metric tons).

$EF_{N_2O,t}$  =  $N_2O$  emissions factor for nitric acid train "t" (lb  $N_2O$ /ton nitric acid produced).

$P_t$  = Annual nitric acid produced from nitric acid train "t" (ton acid produced, 100 percent acid basis).



$DF_N$  = Destruction efficiency of  $N_2O$  abatement technology "N" (decimal fraction of  $N_2O$  removed from vent stream).

$AF_N$  = Abatement utilization factor of  $N_2O$  abatement technology "N" (decimal fraction of time that abatement technology "N" is operating).

$FC_N$  = Fraction control factor of  $N_2O$  abatement technology "N" (decimal fraction of total emissions from nitric acid train "t" that are sent to abatement technology "N").

2205 = Conversion factor (lb/metric ton).

N = Number of different  $N_2O$  abatement technologies with a fraction control factor.

- (4) If nitric acid train "t" does not exhaust to any  $N_2O$  abatement technology after the test point, you must use the emissions factor (determined in Equation V-1 of this section), and the annual nitric acid production (determined in paragraph (i) of this section) according to Equation V-3b of this section:

$$E_{N_2O_t} = \frac{EF_{N_2O_t} \cdot P_t}{2205} \quad (\text{Eq. V-3d})$$

where:

$E_{N_2O_t}$  = Annual  $N_2O$  mass emissions from nitric acid train "t" according to this Equation V-3d (metric tons).

$EF_{N_2O_t}$  = Average site-specific  $N_2O$  emissions factor for nitric acid train "t" (lb  $N_2O$ /ton acid produced, 100 percent acid basis).

$P_t$  = Annual nitric acid production from nitric acid train "t" (ton acid produced, 100 percent acid basis).

2205 = Conversion factor (lb/metric ton).

- (h) You must determine the annual nitric acid production emissions combined from all nitric acid trains at your facility using Equation V-4 of this section:

$$N_2O = \sum_{t=1}^m E_{N_2O_t} \quad (\text{Eq. V-4})$$

Where:

$N_2O$  = Annual process  $N_2O$  emissions from nitric acid production facility (metric tons).

$E_{N_2O_t}$  =  $N_2O$  mass emissions per year for nitric acid train "t" (metric tons).

m = Number of nitric acid trains.

- (i) You must determine the total annual amount of nitric acid produced on each nitric acid train “t” (tons acid produced, 100 percent acid basis), according to § 98.224(f).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66466, Oct. 28, 2010; 78 FR 71959, Nov. 29, 2013; 81 FR 89260, Dec. 9, 2016]

## § 98.224 Monitoring and QA/QC requirements.

- (a) You must conduct a new performance test according to a test plan as specified in paragraphs (a)(1) through (3) of this section.
  - (1) Conduct the performance test annually. The test should be conducted at a point during the campaign which is representative of the average emissions rate from the nitric acid campaigns. Facilities must document the methods used to determine the representative point of the campaign when the performance test is conducted.
  - (2) Conduct the performance test when your nitric acid production process is changed, specifically when abatement equipment is installed.
  - (3) If you requested Administrator approval for an alternative method of determining N<sub>2</sub>O emissions under § 98.223(a)(2), you must conduct the performance test if your request has not been approved by the Administrator within 150 days of the end of the reporting year in which it was submitted.
- (b) You must measure the N<sub>2</sub>O concentration during the performance test using one of the methods in paragraphs (b)(1) through (b)(3) of this section.
  - (1) EPA Method 320 at 40 CFR part 63, appendix A, Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy.
  - (2) ASTM D6348-03 Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy (incorporated by reference in § 98.7).
  - (3) An equivalent method, with Administrator approval.
- (c) You must determine the production rate(s) (100 percent acid basis) from each nitric acid train during the performance test according to paragraphs (c)(1) or (2) of this section.
  - (1) Direct measurement of production and concentration (such as using flow meters, weigh scales, for production and concentration measurements).
  - (2) Existing plant procedures used for accounting purposes (i.e. dedicated tank-level and acid concentration measurements).
- (d) You must determine the volumetric flow rate during the performance test in conjunction with the applicable EPA methods in 40 CFR part 60, appendices A-1 through A-4. Conduct three emissions test runs of 1 hour each. All QA/QC procedures specified in the reference test methods and any associated performance specifications apply. For each test, the facility must prepare an emission factor determination report that must include the items in paragraphs (d)(1) through (d)(3) of this section.
  - (1) Analysis of samples, determination of emissions, and raw data.
  - (2) All information and data used to derive the emissions factor(s).
  - (3) The production rate during each test and how it was determined.

- (e) You must determine the total monthly amount of nitric acid produced. You must also determine the monthly amount of nitric acid produced while N<sub>2</sub>O abatement technology is operating from each nitric acid train. These monthly amounts are determined according to the methods in paragraphs (c)(1) or (2) of this section.
- (f) You must determine the annual amount of nitric acid produced. You must also determine the annual amount of nitric acid produced while N<sub>2</sub>O abatement technology is operating for each nitric acid train. These annual amounts are determined by summing the respective monthly nitric acid quantities determined in paragraph (e) of this section.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66467, Oct. 28, 2010; 78 FR 71960, Nov. 29, 2013]

### § 98.225 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in paragraphs (a) and (b) of this section.

- (a) For each missing value of nitric acid production, the substitute data shall be the best available estimate based on all available process data or data used for accounting purposes (such as sales records).
- (b) For missing values related to the performance test, including emission factors, production rate, and N<sub>2</sub>O concentration, you must conduct a new performance test according to the procedures in § 98.224 (a) through (d).

### § 98.226 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (q) of this section.

- (a) Nitric Acid train identification number.
- (b) Annual process N<sub>2</sub>O emissions from each nitric acid train (metric tons).
- (c)-(d) [Reserved]
- (e) Annual nitric acid production from the nitric acid facility (tons, 100 percent acid basis).
- (f) Number of nitric acid trains.
- (g) Number of different N<sub>2</sub>O abatement technologies per nitric acid train “t”.
- (h) Abatement technologies used (if applicable) and date of installation of abatement technology.
- (i)-(j) [Reserved]
- (k) Type of nitric acid process used for each nitric acid train (low, medium, high, or dual pressure).
- (l) Number of times in the reporting year that missing data procedures were followed to measure nitric acid production (months).
- (m) If you conducted a performance test and calculated a site-specific emissions factor according to § 98.223(a)(1), each annual report must also contain the information specified in paragraphs (m)(1) through (7) of this section.

(1) [Reserved]

(2) Test method used for performance test.

(3)-(6) [Reserved]

(7) Number of times in the reporting year that a performance test had to be repeated (number).

(n) If you requested Administrator approval for an alternative method of determining N<sub>2</sub>O emissions under § 98.223(a)(2), each annual report must also contain the information specified in paragraphs (n)(1) through (4) of this section.

(1) Name of alternative method.

(2) Description of alternative method.

(3) Request date.

(4) Approval date.

(o) [Reserved]

(p) [Reserved]

(q) Annual percent N<sub>2</sub>O emission reduction for all nitric acid trains combined.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66468, Oct. 28, 2010; 75 FR 79157, Dec. 17, 2010; 78 FR 71960, Nov. 29, 2013; 79 FR 63793, Oct. 24, 2014; 81 FR 89260, Dec. 9, 2016]

## § 98.227 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the records specified in paragraphs (a) through (h) of this section for each nitric acid production facility:

(a) Records of significant changes to process.

(b) Documentation of how process knowledge was used to estimate abatement technology destruction efficiency (if applicable).

(c) Performance test reports.

(d) Number of operating hours in the calendar year for each nitric acid train (hours).

(e) Annual nitric acid permitted production capacity (tons).

(f) Measurements, records, and calculations used to determine reported parameters.

(g) Documentation of the procedures used to ensure the accuracy of the measurements of all reported parameters, including but not limited to, calibration of weighing equipment, flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.

(h) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (h)(1) through (10) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (h)(1) through (10) of this section.

- (1) Annual nitric acid produced from each nitric acid train (tons nitric acid produced, 100% acid basis).
- (2) Indicate which equation was used to calculate emissions for each nitric acid train.
- (3) N<sub>2</sub>O concentration per test run during the performance test (ppm N<sub>2</sub>O) (Equation V-1 of § 98.223).
- (4) Volumetric flow rate of effluent gas per test run during the performance test (dscf/hr) (Equation V-1).
- (5) Production rate per test run during the performance test (tons nitric acid produced per hour, 100 percent acid basis) (Equation V-1).
- (6) Annual nitric acid production from each nitric acid train during which each N<sub>2</sub>O abatement technology was operational (tons nitric acid produced, 100 percent acid basis) (Equation V-2 of § 98.223).
- (7) Destruction efficiency of N<sub>2</sub>O abatement technology that is used on each nitric acid train (decimal fraction of N<sub>2</sub>O removed from vent stream) (Equation V-3a of § 98.223).
- (8) Destruction efficiency of each N<sub>2</sub>O abatement technology that is used on each nitric acid train (decimal fraction of N<sub>2</sub>O removed from vent stream) (Equation V-3b of § 98.223).
- (9) Destruction efficiency of each N<sub>2</sub>O abatement technology that is used on each nitric acid train (decimal fraction of N<sub>2</sub>O removed from vent stream) (Equation V-3c of § 98.223).
- (10) Fraction control factor of each N<sub>2</sub>O abatement technology that is used on each nitric acid train (decimal fraction of total emissions from nitric acid train “t” that are sent to abatement technology “n”) (Equation V-3c).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63793, Oct. 24, 2014]

## § 98.228 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart W—Petroleum and Natural Gas Systems

**Source:** 75 FR 74488, Nov. 30, 2010, unless otherwise noted.

## § 98.230 Definition of the source category.

- (a) This source category consists of the following industry segments:
  - (1) **Offshore petroleum and natural gas production.** Offshore petroleum and natural gas production is any platform structure, affixed temporarily or permanently to offshore submerged lands, that houses equipment to extract hydrocarbons from the ocean or lake floor and that processes and/or transfers such hydrocarbons to storage, transport vessels, or onshore. In addition, offshore production includes secondary platform structures connected to the platform structure via walkways, storage tanks associated with the platform structure and floating production and storage offloading equipment (FPSO). This source category does not include reporting of emissions from offshore drilling and exploration that is not conducted on production platforms.

- (2) **Onshore petroleum and natural gas production.** Onshore petroleum and natural gas production means all equipment on a single well-pad or associated with a single well-pad (including but not limited to compressors, generators, dehydrators, storage vessels, engines, boilers, heaters, flares, separation and processing equipment, and portable non-self-propelled equipment, which includes well drilling and completion equipment, workover equipment, and leased, rented or contracted equipment) used in the production, extraction, recovery, lifting, stabilization, separation or treating of petroleum and/or natural gas (including condensate). This equipment also includes associated storage or measurement vessels, all petroleum and natural gas production equipment located on islands, artificial islands, or structures connected by a causeway to land, an island, or an artificial island. Onshore petroleum and natural gas production also means all equipment on or associated with a single enhanced oil recovery (EOR) well-pad using CO<sub>2</sub> or natural gas injection.
- (3) **Onshore natural gas processing.** Onshore natural gas processing means the forced extraction of natural gas liquids (NGLs) from field gas, fractionation of mixed NGLs to natural gas products, or both. Natural gas processing does not include a Joule-Thomson valve, a dew point depression valve, or an isolated or standalone Joule-Thomson skid. This segment also includes all residue gas compression equipment owned or operated by the natural gas processing plant.
- (4) **Onshore natural gas transmission compression.** Onshore natural gas transmission compression means any stationary combination of compressors that move natural gas from production fields, natural gas processing plants, or other transmission compressors through transmission pipelines to natural gas distribution pipelines, LNG storage facilities, or into underground storage. In addition, a transmission compressor station includes equipment for liquids separation, and tanks for the storage of water and hydrocarbon liquids. Residue (sales) gas compression that is part of onshore natural gas processing plants are included in the onshore natural gas processing segment and are excluded from this segment.
- (5) **Underground natural gas storage.** Underground natural gas storage means subsurface storage, including depleted gas or oil reservoirs and salt dome caverns that store natural gas that has been transferred from its original location for the primary purpose of load balancing (the process of equalizing the receipt and delivery of natural gas); natural gas underground storage processes and operations (including compression, dehydration and flow measurement, and excluding transmission pipelines); and all the wellheads connected to the compression units located at the facility that inject and recover natural gas into and from the underground reservoirs.
- (6) **Liquefied natural gas (LNG) storage.** LNG storage means onshore LNG storage vessels located above ground, equipment for liquefying natural gas, compressors to capture and re-liquefy boil-off-gas, re-condensers, and vaporization units for re-gasification of the liquefied natural gas.
- (7) **LNG import and export equipment.** LNG import equipment means all onshore or offshore equipment that receives imported LNG via ocean transport, stores LNG, re-gasifies LNG, and delivers re-gasified natural gas to a natural gas transmission or distribution system. LNG export equipment means all onshore or offshore equipment that receives natural gas, liquefies natural gas, stores LNG, and transfers the LNG via ocean transportation to any location, including locations in the United States.
- (8) **Natural gas distribution.** Natural gas distribution means the distribution pipelines and metering and regulating equipment at metering-regulating stations that are operated by a Local Distribution Company (LDC) within a single state that is regulated as a separate operating company by a public utility commission or that is operated as an independent municipally-owned distribution system.

This segment also excludes customer meters and regulators, infrastructure, and pipelines (both interstate and intrastate) delivering natural gas directly to major industrial users and farm taps upstream of the local distribution company inlet.

- (9) **Onshore petroleum and natural gas gathering and boosting.** Onshore petroleum and natural gas gathering and boosting means gathering pipelines and other equipment used to collect petroleum and/or natural gas from onshore production gas or oil wells and used to compress, dehydrate, sweeten, or transport the petroleum and/or natural gas to a downstream endpoint, typically a natural gas processing facility, a natural gas transmission pipeline or a natural gas distribution pipeline. Gathering and boosting equipment includes, but is not limited to gathering pipelines, separators, compressors, acid gas removal units, dehydrators, pneumatic devices/pumps, storage vessels, engines, boilers, heaters, and flares. Gathering and boosting equipment does not include equipment reported under any other industry segment defined in this section. Gathering pipelines operating on a vacuum and gathering pipelines with a GOR less than 300 standard cubic feet per stock tank barrel (scf/STB) are not included in this industry segment (oil here refers to hydrocarbon liquids of all API gravities).
- (10) **Onshore natural gas transmission pipeline.** Onshore natural gas transmission pipeline means all natural gas transmission pipelines as defined in § 98.238.

(b) [Reserved]

[75 FR 74488, Nov. 30, 2010, as amended at 76 FR 80574, Dec. 23, 2011; 79 FR 70385, Nov. 25, 2014; 80 FR 64283, Oct. 22, 2015; 89 FR 42221, May 14, 2024]

### § 98.231 Reporting threshold.

- (a) You must report GHG emissions under this subpart if your facility contains petroleum and natural gas systems and the facility meets the requirements of § 98.2(a)(2), except for the industry segments in paragraphs (a)(1) through (4) of this section.
- (1) Facilities must report emissions from the onshore petroleum and natural gas production industry segment only if emission sources specified in § 98.232(c) emit 25,000 metric tons of CO<sub>2</sub> equivalent or more per year.
- (2) Facilities must report emissions from the natural gas distribution industry segment only if emission sources specified in § 98.232(i) emit 25,000 metric tons of CO<sub>2</sub> equivalent or more per year.
- (3) Facilities must report emissions from the onshore petroleum and natural gas gathering and boosting industry segment only if emission sources specified in § 98.232(j) emit 25,000 metric tons of CO<sub>2</sub> equivalent or more per year.
- (4) Facilities must report emissions from the onshore natural gas transmission pipeline industry segment only if emission sources specified in § 98.232(m) emit 25,000 metric tons of CO<sub>2</sub> equivalent or more per year.
- (b) For applying the threshold defined in § 98.2(a)(2), natural gas processing facilities must also include owned or operated residue gas compression equipment.

[75 FR 74488, Nov. 30, 2010, as amended at 80 FR 64284, Oct. 22, 2015]

## § 98.232 GHGs to report.

- (a) You must report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each industry segment specified in paragraphs (b) through (j) and (m) of this section, CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each flare as specified in paragraphs (b) through (j) of this section, and stationary and portable combustion emissions as applicable as specified in paragraph (k) of this section. You must also report the information specified in paragraph (l) of this section, as applicable.
- (b) For offshore petroleum and natural gas production, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources. Offshore platforms do not need to report emissions from portable equipment.
  - (1) Equipment leaks (*i.e.*, fugitives), vented emission, and flare emission source types as identified by Bureau of Ocean Energy Management (BOEM) in compliance with 30 CFR 550.302 through 304.
  - (2) Other large release events.
- (c) For an onshore petroleum and natural gas production facility, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from only the following source types on a single well-pad or associated with a single well-pad:
  - (1) Natural gas pneumatic device venting.
  - (2) Blowdown vent stacks.
  - (3) Natural gas driven pneumatic pump venting.
  - (4) Well venting for liquids unloading.
  - (5) Gas well venting during well completions without hydraulic fracturing.
  - (6) Well venting during well completions with hydraulic fracturing that have a GOR of 300 scf/STB or greater (oil here refers to hydrocarbon liquids produced of all API gravities).
  - (7) Gas well venting during well workovers without hydraulic fracturing.
  - (8) Well venting during well workovers with hydraulic fracturing that have a GOR of 300 scf/STB or greater (oil here refers to hydrocarbon liquids produced of all API gravities).
  - (9) Flare stack emissions.
  - (10) Hydrocarbon liquids and produced water storage tank emissions.
  - (11) Reciprocating compressor venting.
  - (12) Well testing venting and flaring.
  - (13) Associated gas venting and flaring from produced hydrocarbons.
  - (14) Dehydrator vents.
  - (15) [Reserved]
  - (16) EOR injection pump blowdown.
  - (17) Acid gas removal unit vents and nitrogen removal unit vents.
  - (18) EOR hydrocarbon liquids dissolved CO<sub>2</sub>.
  - (19) Centrifugal compressor venting.



- (20) [Reserved]
- (21) Equipment leaks listed in paragraph (c)(21)(i) or (ii) of this section, as applicable:
  - (i) Equipment leaks from components including valves, connectors, open ended lines, pressure relief valves, pumps, flanges, and other components (such as instruments, loading arms, stuffing boxes, compressor seals, dump lever arms, and breather caps, but does not include components listed in paragraph (c)(11) or (19) of this section, and it does not include thief hatches or other openings on a storage vessel).
  - (ii) Equipment leaks from major equipment including wellheads, separators, meters/piping, compressors, dehydrators, heaters, and storage vessels.
- (22) You must use the methods in § 98.233(z) and report under this subpart the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from stationary or portable fuel combustion equipment that cannot move on roadways under its own power and drive train, and that is located at an onshore petroleum and natural gas production facility as defined in § 98.238. Stationary or portable equipment are the following equipment, which are integral to the extraction, processing, or movement of oil or natural gas: well drilling and completion equipment, workover equipment, natural gas dehydrators, natural gas compressors, electrical generators, steam boilers, and process heaters.
- (23) Other large release events.
- (24) Drilling mud degassing.
- (25) Crankcase vents.
- (d) For onshore natural gas processing, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources:
  - (1) Reciprocating compressor venting.
  - (2) Centrifugal compressor venting.
  - (3) Blowdown vent stacks.
  - (4) Dehydrator vents.
  - (5) Acid gas removal unit vents and nitrogen removal unit vents.
  - (6) Flare stack emissions.
  - (7) Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters, and equipment leaks from all other components in gas service (not including thief hatches or other openings on storage vessels) that either are subject to equipment leak standards for onshore natural gas processing plants in § 60.5400b or § 60.5401b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a).
  - (8) Natural gas pneumatic device venting.
  - (9) Other large release events.
  - (10) Hydrocarbon liquids and produced water storage tank emissions.
  - (11) Crankcase vents.

- (e) For onshore natural gas transmission compression, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources:
- (1) Reciprocating compressor venting.
  - (2) Centrifugal compressor venting.
  - (3) Condensate storage tanks.
  - (4) Blowdown vent stacks.
  - (5) Natural gas pneumatic device venting.
  - (6) Flare stack emissions.
  - (7) Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters.
  - (8) Equipment leaks from all other components that are not listed in paragraph (e)(1), (2), or (7) of this section and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, or that you elect to survey using a leak detection method described in § 98.234(a). The other components subject to this paragraph (e)(8) also do not include thief hatches or other openings on a storage vessel.
  - (9) Other large release events.
  - (10) Dehydrator vents.
  - (11) Crankcase vents.
- (f) For underground natural gas storage, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources:
- (1) Reciprocating compressor venting.
  - (2) Centrifugal compressor venting.
  - (3) Natural gas pneumatic device venting.
  - (4) Flare stack emissions.
  - (5) Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters associated with storage stations.
  - (6) Equipment leaks from all other components that are associated with storage stations, are not listed in paragraph (f)(1), (2), or (5) of this section, and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a). The other components subject to this paragraph (f)(6) do not include thief hatches or other openings on a storage vessel.
  - (7) Equipment leaks from valves, connectors, open-ended lines, and pressure relief valves associated with storage wellheads.

- (8) Equipment leaks from all other components that are associated with storage wellheads, are not listed in paragraph (f)(1), (2), or (7) of this section, and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a).
  - (9) Other large release events.
  - (10) Dehydrator vents.
  - (11) Blowdown vent stacks.
  - (12) Condensate storage tanks.
  - (13) Crankcase vents.
- (g) For LNG storage, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources:
- (1) Reciprocating compressor venting.
  - (2) Centrifugal compressor venting.
  - (3) Flare stack emissions.
  - (4) Equipment leaks from valves, pump seals, connectors, and other equipment leak sources in LNG service.
  - (5) Equipment leaks from vapor recovery compressors, if you do not survey components associated with vapor recovery compressors in accordance with paragraph (g)(6) of this section.
  - (6) Equipment leaks from all components in gas service that are associated with a vapor recovery compressor, are not listed in paragraph (g)(1) or (2) of this section, and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a).
  - (7) Equipment leaks from all components in gas service that are not associated with a vapor recovery compressor, are not listed in paragraph (g)(1) or (2) of this section, and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a).
  - (8) Other large release events.
  - (9) Blowdown vent stacks.
  - (10) Acid gas removal unit vents and nitrogen removal unit vents.
  - (11) Crankcase vents.

- (h) LNG import and export equipment, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources:
- (1) Reciprocating compressor venting.
  - (2) Centrifugal compressor venting.
  - (3) Blowdown vent stacks.
  - (4) Flare stack emissions.
  - (5) Equipment leaks from valves, pump seals, connectors, and other equipment leak sources in LNG service.
  - (6) Equipment leaks from vapor recovery compressors, if you do not survey components associated with vapor recovery compressors in accordance with paragraph (h)(7) of this section.
  - (7) Equipment leaks from all components in gas service that are associated with a vapor recovery compressor, are not listed in paragraph (h)(1) or (2) of this section, and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a).
  - (8) Equipment leaks from all components in gas service that are not associated with a vapor recovery compressor, are not listed in paragraph (h)(1) or (2) of this section, and either are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or § 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or that you elect to survey using a leak detection method described in § 98.234(a).
  - (9) Acid gas removal unit vents and nitrogen removal unit vents.
  - (10) Other large release events.
  - (11) Crankcase vents.
- (i) For natural gas distribution, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following sources:
- (1) Equipment leaks from connectors, block valves, control valves, pressure relief valves, orifice meters, regulators, and open-ended lines at above grade transmission-distribution transfer stations.
  - (2) Equipment leaks at below grade transmission-distribution transfer stations.
  - (3) Equipment leaks at above grade metering-regulating stations that are not above grade transmission-distribution transfer stations.
  - (4) Equipment leaks at below grade metering-regulating stations.
  - (5) Distribution main equipment leaks.
  - (6) Distribution services equipment leaks.
  - (7) Report under subpart W of this part the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from stationary fuel combustion sources following the methods in § 98.233(z).

- (8) Other large release events.
- (9) Blowdown vent stacks.
- (10) Natural gas pneumatic device venting.
- (11) Crankcase vents.
- (j) For an onshore petroleum and natural gas gathering and boosting facility, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following source types:
  - (1) Natural gas pneumatic device venting.
  - (2) Natural gas driven pneumatic pump venting.
  - (3) Acid gas removal unit vents and nitrogen removal unit vents.
  - (4) Dehydrator vents.
  - (5) Blowdown vent stacks.
  - (6) Hydrocarbon liquids and produced water storage tank emissions.
  - (7) Flare stack emissions.
  - (8) Centrifugal compressor venting.
  - (9) Reciprocating compressor venting.
  - (10) Equipment leaks listed in paragraph (j)(10)(i) or (ii) of this section, as applicable:
    - (i) Equipment leaks from components including valves, connectors, open ended lines, pressure relief valves, pumps, flanges, and other components (such as instruments, loading arms, stuffing boxes, compressor seals, dump lever arms, and breather caps, but does not include components in paragraph (j)(8) or (9) of this section, and it does not include thief hatches or other openings on a storage vessel).
    - (ii) Equipment leaks from major equipment including wellheads, separators, meters/piping, compressors, dehydrators, heaters, and storage vessels.
  - (11) Gathering pipeline equipment leaks.
  - (12) You must use the methods in § 98.233(z) and report under this subpart the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from stationary or portable fuel combustion equipment that cannot move on roadways under its own power and drive train, and that is located at an onshore petroleum and natural gas gathering and boosting facility as defined in § 98.238. Stationary or portable equipment includes the following equipment, which are integral to the movement of natural gas: Natural gas dehydrators, natural gas compressors, electrical generators, steam boilers, and process heaters.
  - (13) Other large release events.
  - (14) Crankcase vents.
- (k) Report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary fuel combustion unit by following the requirements of subpart C except for facilities under onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting, and natural gas distribution. Onshore petroleum and natural gas production facilities must report stationary and portable combustion emissions as specified in paragraph (c) of this

section. Natural gas distribution facilities must report stationary combustion emissions as specified in paragraph (i) of this section. Onshore petroleum and natural gas gathering and boosting facilities must report stationary and portable combustion emissions as specified in paragraph (j) of this section.

- (l) You must report under subpart PP of this part (Suppliers of Carbon Dioxide), CO<sub>2</sub> emissions captured and transferred off site by following the requirements of subpart PP.
- (m) For onshore natural gas transmission pipeline, report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from the following source types:
  - (1) Blowdown vent stacks.
  - (2) Other large release events.
  - (3) Equipment leaks listed in paragraph (m)(3)(i) or (ii) of this section, as applicable:
    - (i) Equipment leaks at transmission company interconnect metering-regulating stations.
    - (ii) Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters at transmission company interconnect metering-regulating stations.
  - (4) Equipment leaks listed in paragraph (m)(4)(i) or (ii) of this section, as applicable:
    - (i) Equipment leaks at farm tap and/or direct sale metering-regulating stations.
    - (ii) Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters at farm tap and/or direct sale metering-regulating stations.
  - (5) Transmission pipeline equipment leaks.

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## § 98.233 Calculating GHG emissions.

You must calculate and report the annual GHG emissions as prescribed in this section. For calculations that specify measurements in actual conditions, reporters may use a flow or volume measurement system that corrects to standard conditions and determine the flow or volume at standard conditions; otherwise, reporters must use average atmospheric conditions or typical operating conditions as applicable to the respective monitoring methods in this section.

- (a) **Natural gas pneumatic device venting.** Calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from natural gas pneumatic device venting using the applicable provisions as specified in this paragraph (a) of this section. If you have a continuous flow meter on the natural gas supply line dedicated to any one or combination of natural gas pneumatic devices or natural gas driven pneumatic pumps vented directly to the atmosphere for any portion of the year, you must use the method specified in paragraph (a)(1) of this section to calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from those devices. For natural gas pneumatic devices vented directly to the atmosphere for which the natural gas supply rate is not continuously measured, use the applicable methods specified in paragraphs (a)(2) through (7) of this section to calculate CH<sub>4</sub> and CO<sub>2</sub> emissions. For natural gas pneumatic devices that are routed to flares, combustion, or vapor recovery systems, use the applicable provisions specified in paragraphs (a)(8) of this section. All references to natural gas

pneumatic devices for Calculation Method 1 in this paragraph (a) also apply to combinations of natural gas pneumatic devices and natural gas driven pneumatic pumps that are served by a common natural gas supply line.

(1) **Calculation Method 1.** If you have or elect to install a continuous flow meter that is capable of meeting the requirements of § 98.234(b) on the natural gas supply line dedicated to any one or combination of natural gas pneumatic devices and natural gas driven pneumatic pumps that are vented directly to the atmosphere, you must use the applicable methods specified in paragraph (a)(1)(i) through (iv) of this section to calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from those devices.

(i) For volumetric flow monitors:

- (A) Determine the cumulative annual volumetric flow, in standard cubic feet, as measured by the flow monitor in the reporting year. If all natural gas pneumatic devices supplied by the measured natural gas supply line are routed to the atmosphere for only a portion of the year and are routed to a flare, combustion, or vapor recovery system for the remaining portion of the year, determine the cumulative annual volumetric flow considering only those times when one or more of the natural gas pneumatic devices were vented directly to the atmosphere. If the flow meter was installed during the year, calculate the total volumetric flow for the year based on the measured volumetric flow times the total hours in the calendar year the devices were in service (*i.e.*, supplied with natural gas) divided by the number of hours the devices were in service (*i.e.*, supplied with natural gas) and the volumetric flow was being measured.
- (B) Convert the natural gas volumetric flow from paragraph (a)(1)(i)(A) of this section to CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions following the provisions in paragraph (u) of this section.
- (C) Convert the CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions from paragraph (a)(1)(i)(B) of this section to CH<sub>4</sub> and CO<sub>2</sub> mass emissions using calculations in paragraph (v) of this section.

(ii) For mass flow monitors:

- (A) Determine the cumulative annual mass flow, in metric tons, as measured by the flow monitor in the reporting year. If all natural gas pneumatic devices supplied by the measured natural gas supply line are vented directly to the atmosphere for only a portion of the year and are routed to a flare, combustion, or vapor recovery system for the remaining portion of the year, determine the cumulative annual mass flow considering only those times when one or more of the natural gas pneumatic devices were vented directly to the atmosphere. If the flow meter was installed during the year, calculate the total mass flow for the year based on the measured mass flow times the total hours in the calendar year the devices were in service (*i.e.*, supplied with natural gas) divided by the number of hours the devices were in service (*i.e.*, supplied with natural gas) and the mass flow was being measured.
- (B) Convert the cumulative mass flow from paragraph (a)(1)(ii)(A) of this section to CH<sub>4</sub> and CO<sub>2</sub> mass emissions by multiplying by the mass fraction of CH<sub>4</sub> and CO<sub>2</sub> in the supplied natural gas. You must follow the provisions in paragraph (u) of this section for determining the mole fraction of CH<sub>4</sub> and CO<sub>2</sub> and use molecular weights of 16 kg/kg-mol and 44 kg/kg-mol for CH<sub>4</sub> and CO<sub>2</sub>, respectively. You may assume unspecified components have an average molecular weight of 28 kg/kg-mol.

- (iii) If the flow meter on the natural gas supply line serves both natural gas pneumatic devices and natural gas driven pneumatic pumps, disaggregate the total measured amount of natural gas to pneumatic devices and natural gas driven pneumatic pumps based on engineering calculations and best available data.
  - (iv) The flow meter must be operated and calibrated according to the methods set forth in § 98.234(b).
- (2) **Calculation Method 2.** Except as provided in paragraph (a)(1) of this section, you may elect to measure the volumetric flow rate of each natural gas pneumatic device vent that vents directly to the atmosphere at your well-pad site, gathering and boosting site, or facility, as applicable, as specified in paragraphs (a)(2)(i) through (ix) of this section. You must exclude the counts of devices measured according to paragraph (a)(1) of this section from the counts of devices to be measured or for which emissions are calculated according to the requirements in this paragraph (a)(2).
- (i) For facilities in the onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting industry segments, you may elect to measure your pneumatic devices according to this Calculation Method 2 for some well-pad sites or gathering and boosting sites and use other methods for other sites. When you elect to measure the emissions from natural gas pneumatic devices according to this Calculation Method 2 at a well-pad site or gathering and boosting site, you must measure all natural gas pneumatic devices that are vented directly to the atmosphere at the well-pad site or gathering and boosting site during the same calendar year and you must measure and calculate emissions according to the provisions in paragraphs (a)(2)(iii) through (viii) of this section.
  - (ii) For facilities in the onshore natural gas processing, onshore natural gas transmission compression, underground natural gas storage, or natural gas distribution industry segments electing to use this Calculation Method 2, you must measure all natural gas pneumatic devices vented directly to the atmosphere at your facility each year or, if your facility has 26 or more pneumatic devices, over multiple years, not to exceed the number of years as specified in paragraphs (a)(2)(ii)(A) through (D) of this section. If you elect to measure your pneumatic devices over multiple years, you must measure approximately the same number of devices each year. You must measure and calculate emissions for natural gas pneumatic devices at your facility according to the provisions in paragraphs (a)(2)(iii) through (ix), as applicable.
    - (A) If your facility has at least 26 but not more than 50 natural gas pneumatic devices vented directly to the atmosphere, the maximum number of years to measure all devices at your facility is 2 years.
    - (B) If your facility has at least 51 but not more than 75 natural gas pneumatic devices vented directly to the atmosphere, the maximum number of years to measure all devices at your facility is 3 years.
    - (C) If your facility has at least 76 but not more than 100 natural gas pneumatic devices vented directly to the atmosphere, the maximum number of years to measure all devices at your facility is 4 years.
    - (D) If your facility has 101 or more natural gas pneumatic devices vented directly to the atmosphere, the maximum number of years to measure all devices at your facility is 5 years.



- (iii) For all industry segments, determine the volumetric flow rate of each natural gas pneumatic device vent (in standard cubic feet per hour) using one of the methods specified in § 98.234(b) through (d), as appropriate, according to the requirements specified in paragraphs (a)(2)(iii)(A) through (E) of this section. You must measure the emissions under conditions representative of normal operations, which excludes periods immediately after conducting maintenance on the device or manually actuating the device.
  - (A) If you use a temporary meter, such as a vane anemometer, according to the methods set forth in § 98.234(b) or a high volume sampler according to methods set forth in § 98.234(d), you must measure the emissions from each device for a minimum of 15 minutes while the device is in service (i.e., supplied with natural gas), except for natural gas pneumatic isolation valve actuators. For natural gas pneumatic isolation valve actuators, you must measure the emissions from each device for a minimum of 5 minutes while the device is in service (i.e., supplied with natural gas). If there is no measurable flow from the natural gas pneumatic device after the minimum sampling period, you can discontinue monitoring and follow the applicable methods in paragraph (a)(2)(v) of this section.
  - (B) If you use calibrated bagging, follow the methods set forth in § 98.234(c) except you need only fill one bag to have a valid measurement. You must collect sample for a minimum of 5 minutes for natural gas pneumatic isolation valve actuators or 15 minutes for other natural gas pneumatic devices. If no gas is collected in the calibrated bag during the minimum sampling period, you can discontinue monitoring and follow the applicable methods in paragraph (a)(2)(v) of this section. If gas is collected in the bag during the minimum sampling period, you must either continue sampling until you fill the calibrated bag or you may elect to remeasure the vent according to paragraph (a)(2)(iii)(A) of this section.
  - (C) You do not need to use the same measurement method for each natural gas pneumatic device vent.
  - (D) If the measurement method selected measures the volumetric flow rate in actual cubic feet, convert the measured flow to standard cubic feet following the methods specified in paragraph (t)(1) of this section.
  - (E) If there is measurable flow from the device vent, calculate the volumetric flow rate of each natural gas pneumatic device vent (in standard cubic feet per hour) by dividing the cumulative volume of natural gas measured during the measurement period (in standard cubic feet) by the duration of the measurement (in hours).
- (iv) For all industry segments, if there is measurable flow from the device vent, calculate the volume of natural gas emitted from each natural gas pneumatic device vent as the product of the natural gas flow rate measured in paragraph (a)(2)(iii) of this section and the number of hours the pneumatic device was in service (i.e., supplied with natural gas) in the calendar year.
- (v) For all industry segments, if there is no measurable flow from the device vent, estimate the emissions from the device according to the methods in paragraphs (a)(2)(v)(A) through (C) of this section, as applicable.
  - (A) For continuous high bleed pneumatic devices:

- (1) Confirm that the device is in-service. If not, remeasure the device according to paragraph (a)(2)(iii) of this section at a time the device is in-service and calculate natural gas emissions from the device according to paragraph (a)(2)(iv) of this section.
  - (2) Confirm that the device is correctly characterized as a continuous high bleed pneumatic device according to the provisions in paragraph (a)(7) of this section. If the device type was mischaracterized, recharacterize the device type and use the appropriate methods in paragraph (a)(2)(v)(B) or (C) of this section, as applicable.
  - (3) Upon confirmation of the items in paragraphs (a)(2)(v)(A)(1) and (2) of this section, remeasure the device vent using a different measurement method specified in § 98.234(b) through (d) or longer monitoring duration until there is a measurable flow from the device and calculate the natural gas emissions from the device according to paragraph (a)(2)(iv) of this section.
- (B) For continuous low bleed pneumatic devices:
- (1) Confirm that the device is in-service. If not, remeasure the device according to paragraph (a)(2)(iii) of this section at a time the device is in-service and calculate natural gas emissions from the device according to paragraph (a)(2)(iv) of this section.
  - (2) Determine natural gas bleed rate (in standard cubic feet per hour) at the supply pressure used for the pneumatic device based on the manufacturer's steady state natural gas bleed rate reported for the device. If the steady state bleed rate is reported in terms of air consumption, multiply the air consumption rate by 1.29 to calculate the steady state natural gas bleed rate. If a steady state bleed rate is not reported, follow the requirements in paragraph (a)(2)(v)(B)(4) of this section.
  - (3) Calculate the volume of natural gas emitted from the natural gas pneumatic device vent as the product of the natural gas steady state bleed rate determined in paragraph (a)(2)(v)(B)(2) of this section and number of hours the pneumatic device was in service (*i.e.*, supplied with natural gas) in the calendar year.
  - (4) If a steady state bleed rate is not reported, reassess whether the device is correctly characterized as a continuous low bleed pneumatic device according to the provisions in paragraph (a)(7) of this section. If the device is confirmed to be a continuous low bleed pneumatic device, you must remeasure the device vent using a different measurement method specified in § 98.234(b) through (d) or longer monitoring duration until there is a measurable flow from the device and calculate natural gas emissions from the device according to paragraph (a)(2)(iv) of this section. If the device type was mischaracterized, recharacterize the device type and use the appropriate methods in paragraph (a)(2)(v)(A) or (C) of this section, as applicable.
- (C) For intermittent bleed pneumatic devices:

- (1) Confirm that the device is in-service. If not, remeasure the device according to paragraph (a)(2)(iii) of this section at a time the device is in-service and calculate natural gas emissions according to paragraph (a)(2)(iv) of this section. For devices confirmed to be in-service during the measurement period, calculate natural gas emissions according to paragraphs (a)(2)(v)(C)(2) through (5) of this section.
- (2) Calculate the volume of the controller, tubing and actuator (in actual cubic feet) based on the device and tubing size.
- (3) Sum the volumes in paragraph (a)(2)(v)(C)(2) of this section and convert the volume to standard cubic feet following the methods specified in paragraph (t)(1) of this section based on the natural gas supply pressure.
- (4) Estimate the number of actuations during the year based on company records, if available, or best engineering estimates. For isolation valve actuators, you may multiply the number of valve closures during the year by 2 (one actuation to close the valve; one actuation to open the valve).
- (5) Calculate the volume of natural gas emitted from the natural gas pneumatic device vent as the product of the per actuation volume in standard cubic feet determined in paragraph (a)(2)(v)(C)(3) of this section, the number of actuations during the year as determined in paragraph (a)(2)(v)(C)(4) of this section, and the relay correction factor. Use 1 for the relay correction factor if there is no relay; use 3 for the relay correction factor if there is a relay.
- (vi) For each pneumatic device, convert the volumetric emissions of natural gas at standard conditions determined in paragraph (a)(2)(iv) or (v) of this section, as applicable, to CO<sub>2</sub> and CH<sub>4</sub> volumetric emissions at standard conditions using the methods specified in paragraph (u) of this section.
- (vii) For each pneumatic device, convert the GHG volumetric emissions at standard conditions determined in paragraph (a)(2)(vi) of this section to GHG mass emissions using the methods specified in paragraph (v) of this section.
- (viii) Sum the CO<sub>2</sub> and CH<sub>4</sub> mass emissions determined in paragraph (a)(2)(vii) of this section separately for each type of natural gas pneumatic device (continuous high bleed, continuous low bleed, and intermittent bleed).
- (ix) For facilities in the onshore natural gas processing, onshore natural gas transmission compression, underground natural gas storage, or natural gas distribution industry segments, if you chose to conduct natural gas pneumatic device measurements over multiple years, "n," according to paragraph (a)(2)(ii) of this section, then you must calculate the emissions from all pneumatic devices at your facility as specified in paragraph (a)(2)(ix)(A) through (E) of this section.
  - (A) Use the emissions calculated in (a)(2)(viii) of this section for the devices measured during the reporting year.
  - (B) Calculate the whole gas emission factor for each type of pneumatic device at the facility using equation W-1A to this section and all available data from the current year and the previous years in your monitoring cycle (n-1 years) for which natural gas pneumatic device

vent measurements were made according to Calculation Method 2 in paragraph (a)(2) of this section (e.g., if your monitoring cycle is 3 years, then use measured data from the current year and the two previous years). This emission factor must be updated annually.

$$EF_t = \frac{\sum_{y=1}^n MT_{s,t,y}}{\sum_{y=1}^n Count_{t,y}} \quad (\text{Eq. W-1A})$$

Where:

$EF_t$  = Whole gas population emission factor for natural gas pneumatic device vents of type "t" (continuous high bleed, continuous low bleed, intermittent bleed), in standard cubic feet per hour per device.

$MT_{s,t,y}$  = Volumetric whole gas emissions rate measurement at standard ("s") conditions from component type "t" during year "y" in standard cubic feet per hour, as calculated in paragraph (a)(2)(iii) [if there was measurable flow from the device vent], (a)(2)(v)(B)(2), or (a)(2)(v)(C)(6) of this section, as applicable.

$Count_{t,y}$  = Count of natural gas pneumatic device vents of type "t" measured according to Calculation Method 2 in year "y."

n = Number of years of data to include in the emission factor calculation according to the number of years used to monitor all natural gas pneumatic device vents at the facility.

- (C) Calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions from continuous high bleed, continuous low bleed, and intermittent bleed natural gas pneumatic devices that were not measured during the reporting year using equation W-1B to this section.

$$E_{s,i} = \sum_{t=1}^3 Count_t * EF_t * GHG_i * T_t \quad (\text{Eq. W-1B})$$

Where:

$E_{s,i}$  = Annual total volumetric GHG emissions at standard conditions in standard cubic feet per year from natural gas pneumatic device vents, of types "t" (continuous high bleed, continuous low bleed, intermittent bleed), for GHG<sub>i</sub>.

$Count_t$  = Total number of natural gas pneumatic devices of type "t" (continuous high bleed, continuous low bleed, intermittent bleed) as determined in paragraphs (a)(5) through (7) of this section that vent directly to the atmosphere and that were not directly measured according to the requirements in paragraph (a)(1) or (a)(2)(iii) of this section.

$EF_t$  = Population emission factors for natural gas pneumatic device vents (in standard cubic feet per hour per device) of each type "t" (continuous high bleed, continuous low bleed, intermittent bleed) as calculated using equation W-1A to this section.

$GHG_i$  = Concentration of GHG<sub>i</sub> CH<sub>4</sub> or CO<sub>2</sub>, in produced natural gas or processed natural gas for each facility as specified in paragraph (u)(2) of this section.

$T_t$  = Average estimated number of hours in the operating year the devices, of each type "t", were in service (i.e., supplied with natural gas) using engineering estimates based on best available data. Default is 8,760 hours.

- (D) Convert the volumetric emissions calculated using equation W-1B to this section to CH<sub>4</sub> and CO<sub>2</sub> mass emissions using the methods specified in paragraph (v) of this section.
  - (E) Sum the CH<sub>4</sub> and CO<sub>2</sub> mass emissions calculated in paragraphs (a)(2)(ix)(A) and (D) of this section separately for each type of pneumatic device (continuous high bleed, continuous low bleed, intermittent bleed) to calculate the total CH<sub>4</sub> and CO<sub>2</sub> mass emissions by device type for Calculation Method 2.
- (3) **Calculation Method 3.** For facilities in the onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting industry segments, you may elect to use the applicable methods specified in paragraphs (a)(3)(i) through (iv) of this section, as applicable, to calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from your natural gas pneumatic devices that are vented directly to the atmosphere at your site except those that are measured according to paragraph (a)(1) or (2) of this section. You must exclude the counts of devices measured according to paragraph (a)(1) of this section from the counts of devices to be monitored or for which emissions are calculated according to the requirements in this paragraph (a)(3). You may not use this Calculation Method 3 for those well-pad sites or gathering and boosting sites for which you elected to measure emissions according to paragraph (a)(2) of this section.
- (i) For continuous high bleed and continuous low bleed natural gas pneumatic devices vented directly to the atmosphere, you must calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions using either the methods in paragraph (a)(3)(i)(A) or (B) of this section.
    - (A) Measure all continuous high bleed and continuous low bleed pneumatic devices at your well-pad site or gathering and boosting site, as applicable, according to the provisions in paragraphs (a)(2) of this section.
    - (B) Use equation W-1B to this section, except use the appropriate default whole gas population emission factors for natural gas pneumatic device vents (in standard cubic feet per hour per device) of each type "t" (continuous high bleed and continuous low bleed) as listed in table W-1 to this subpart.
  - (ii) For intermittent bleed pneumatic devices, you must monitor each intermittent bleed pneumatic device at your well-pad site or gathering and boosting site as specified in paragraphs (a)(3)(ii)(A) through (C) of this section, as applicable.
    - (A) You must use one of the monitoring methods specified in § 98.234(a)(1) through (3) except that the monitoring dwell time for each device vent must be at least 2 minutes or until a malfunction is identified, whichever is shorter. A device is considered malfunctioning if any leak is observed when the device is not actuating or if a leak is observed for more than 5 seconds, or the extended duration as specified in paragraph (a)(3)(ii)(C) of this section if applicable, during a device actuation. If you cannot tell when a device is actuating, any observed leak from the device indicates a malfunctioning device.
    - (B) If you elect to monitor emissions from natural gas pneumatic devices at a well-pad site or gathering and boosting site according to this Calculation Method 3, you must monitor all natural gas intermittent bleed pneumatic devices that are vented directly to the

atmosphere at the well-pad site or gathering and boosting site during the same calendar year. You must monitor the natural gas intermittent bleed pneumatic devices under conditions representative of normal operations, which excludes periods immediately after conducting maintenance on the device or manually actuating the device.

(C) For certain throttling pneumatic devices or isolation valve actuators on pipes greater than 5 inches in diameter, that may actuate for more than 5 seconds under normal conditions, you may elect to identify individual devices for which longer bleed periods may be allowed as specified in paragraphs (a)(3)(ii)(C)(1) and (2) of this section prior to monitoring these devices for the first time.

(1) You must identify the devices for which extended actuations are considered normal operations. For each device identified, you must determine the typical actuation time and maintain documentation and rationale for the extended actuation duration value.

(2) You must clearly and permanently tag the device vent for each natural gas pneumatic device that has an extended actuation duration. The tag must include the device ID and the normal duration period (in seconds) as determined and documented for the device as specified in paragraph (a)(3)(ii)(C)(1) of this section.

(iii) For intermittent bleed pneumatic devices that are monitored according to paragraph (a)(3)(ii) of this section during the reporting year, you must calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions from intermittent bleed natural gas pneumatic devices vented directly to the atmosphere using equation W-1C to this section.

$$E_i = GHG_i \times \left[ \sum_{z=1}^x \{K_1 \times T_{mal,z} + K_2 \times (T_{i,z} - T_{mal,z})\} + (K_2 \times Count \times T_{avg}) \right] \quad (\text{Eq. W-1C})$$

Where:

$E_i$  = Annual total volumetric emissions of GHG<sub>i</sub> from intermittent bleed natural gas pneumatic devices in standard cubic feet.

GHG<sub>i</sub> = Concentration of GHG<sub>i</sub>, CH<sub>4</sub> or CO<sub>2</sub>, in natural gas supplied to the intermittent bleed natural gas pneumatic device as defined in paragraph (u)(2) of this section.

$x$  = Total number of intermittent bleed natural gas pneumatic devices detected as malfunctioning in any pneumatic device monitoring survey during the year. A component found as malfunctioning in two or more surveys during the year is counted as one malfunctioning component.

$K_1$  = Whole gas emission factor for malfunctioning intermittent bleed natural gas pneumatic devices, in standard cubic feet per hour per device. Use 24.1 for well-pad sites in the onshore petroleum and natural gas production industry segment and use 16.1 for gathering and boosting sites in the onshore petroleum and natural gas gathering and boosting industry segment.

$T_{mal,z}$  = The total time the surveyed pneumatic device "z" was in service (i.e., supplied with natural gas) and assumed to be malfunctioning, in hours. If one pneumatic device monitoring survey is conducted in the calendar year, assume the device found malfunctioning was malfunctioning for the entire calendar year. If multiple pneumatic device monitoring surveys are conducted in the calendar year, assume a device found malfunctioning in the first survey was malfunctioning since the beginning of the year until the date of the

survey; assume a device found malfunctioning in the last survey of the year was malfunctioning from the preceding survey through the end of the year; assume a device found malfunctioning in a survey between the first and last surveys of the year was malfunctioning since the preceding survey until the date of the survey; and sum times for all malfunctioning periods.

$T_{tz}$  = The total time the surveyed natural gas pneumatic device "z" was in service (i.e., supplied with natural gas) during the year. Default is 8,760 hours for non-leap years and 8,784 hours for leap years.

$K_2$  = Whole gas emission factor for properly operating intermittent bleed natural gas pneumatic devices, in standard cubic feet per hour per device. Use 0.3 for well-pad sites in the onshore petroleum and natural gas production industry segment and use 2.8 for gathering and boosting sites in the onshore petroleum and natural gas gathering and boosting industry segment.

Count = Total number of intermittent bleed natural gas pneumatic devices that were never observed to be malfunctioning during any monitoring survey during the year.

$T_{avg}$  = The average time the intermittent bleed natural gas pneumatic devices that were never observed to be malfunctioning during any monitoring survey were in service (i.e., supplied with natural gas) using engineering estimates based on best available data. Default is 8,760 hours for non-leap years and 8,784 hours for leap years.

- (A) You must conduct at least one complete pneumatic device monitoring survey in a calendar year. If you conduct multiple complete pneumatic device monitoring surveys in a calendar year, you must use the results from each complete pneumatic device monitoring survey when calculating emissions using equation W-1C to this section.
- (B) For the purposes of paragraph (a)(3)(iii)(A) of this section, a complete monitoring survey is a survey of all intermittent bleed natural gas pneumatic devices vented directly to the atmosphere at a well-pad site for onshore petroleum and natural gas production facilities (except those measured according to paragraph (a)(1) of this section) or all intermittent bleed pneumatic devices vented directly to the atmosphere at a gathering and boosting site for onshore petroleum and natural gas gathering and boosting facilities (except those measured according to paragraph (a)(1) of this section).
- (iv) You must convert the  $CH_4$  and  $CO_2$  volumetric emissions as determined according to paragraphs (a)(3)(i) and (iii) of this section and calculate both  $CO_2$  and  $CH_4$  mass emissions using calculations in paragraph (v) of this section for each type of natural gas pneumatic device (continuous high bleed, continuous low bleed, and intermittent bleed).
- (4) **Calculation Method 4.** For well-pads in the onshore petroleum and natural gas production industry segment, gathering and boosting sites in the onshore petroleum and natural gas gathering and boosting industry segments, or for facilities in the onshore natural gas processing, onshore natural gas transmission compression, underground natural gas storage, or natural gas distribution industry segments, you may elect to calculate  $CH_4$  and  $CO_2$  emissions from your natural gas pneumatic devices that are vented directly to the atmosphere at your site using the methods specified in paragraphs (a)(4)(i) and (ii) of this section except those that are measured according to paragraphs (a)(1) through (3) of this section. You must exclude the counts of devices measured according to paragraph (a)(1) of this section from the counts of devices to be monitored or for which emissions

are calculated according to the requirements in this paragraph (a)(4). You may not use this Calculation Method 4 for those devices for which you elected to measure emissions according to paragraph (a)(1), (2), or (3) of this section.

- (i) You must calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions using equation W-1B to this section, except use the appropriate default whole gas population emission factors for natural gas pneumatic device vents (in standard cubic feet per hour per device) of each type “t” (continuous high bleed, continuous low bleed, and intermittent bleed) as listed in table W-1 to this subpart.
  - (ii) You must convert the CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions as determined according to paragraphs (a)(4)(i) of this section and calculate both CO<sub>2</sub> and CH<sub>4</sub> mass emissions using calculations in paragraph (v) of this section for each type of natural gas pneumatic device (continuous high bleed, continuous low bleed, and intermittent bleed).
- (5) **Counts of natural gas pneumatic devices.** For all industry segments, determine “Countt” for equation W-1A, W-1B, or W-1C to this section for each type of natural gas pneumatic device (continuous high bleed, continuous low bleed, and intermittent bleed) by counting the total number of devices at the well-pad site, gathering and boosting site, or facility, as applicable, the number of devices that are vented directly to the atmosphere and the number of those devices that were measured or monitored during the reporting year, as applicable, except as specified in paragraph (a)(6) of this section.
- (6) **Counts of onshore petroleum and natural gas production industry segment or the onshore petroleum and natural gas gathering and boosting natural gas pneumatic devices.** For facilities in the onshore petroleum and natural gas production industry segment or the onshore petroleum and natural gas gathering and boosting industry segment, you have the option in the first two consecutive calendar years to determine the total number of natural gas pneumatic devices at the facility and the number of devices that are vented directly to the atmosphere for each type of natural gas pneumatic device (continuous high bleed, continuous low bleed, and intermittent bleed), as applicable, using engineering estimates based on best available data. Counts of natural gas pneumatic devices measured or monitored during the reporting year must be made based on actual counts.
- (7) **Type of natural gas pneumatic devices.** For all industry segments, determine the type of natural gas pneumatic device using engineering estimates based on best available information.
- (8) **Routing to flares, combustion, or vapor recovery systems.** Calculate emissions from natural gas pneumatic devices routed to flares, combustion, or vapor recovery systems as specified in paragraph (a)(8)(i) or (ii) of this section, as applicable. If a device was vented directly to the atmosphere for part of the year and routed to a flare, combustion unit, or vapor recovery system during another part of the year, then calculate emissions from the time the device vents directly to the atmosphere as specified in paragraph (a)(1), (2), (3) or (4) of this section, as applicable, and calculate emissions from the time the device was routed to a flare or combustion as specified in paragraph (a)(8)(i) or (ii) of this section, as applicable. During periods when natural gas pneumatic device emissions are collected in a vapor recovery system that is not routed to combustion, paragraphs (a)(1) through (4) and (a)(8)(i) and (ii) of this section do not apply and no emissions calculations are required. Notwithstanding the calculation and emissions reporting requirements as specified in this paragraph (a)(8) of this section, the number of natural gas pneumatic devices routed to flares, combustion, or vapor recovery systems, by type, must be reported as specified in § 98.236(b)(2)(iii).



- (i) If any natural gas pneumatic devices were routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions for the flare stack as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
- (ii) If emissions from any natural gas pneumatic devices were routed to combustion units, you must calculate and report emissions as specified in subpart C of this part or calculate emissions as specified in paragraph (z) of this section and report emissions from the combustion equipment as specified in § 98.236(z), as applicable.

(b) [Reserved]

(c) **Natural gas driven pneumatic pump venting.** Calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from natural gas driven pneumatic pumps venting directly to the atmosphere as specified in paragraph (c)(1), (2), or (3) of this section, as applicable. If you have a continuous flow meter on the natural gas supply line that is dedicated to any one or more natural gas driven pneumatic pumps, each of which only vents directly to the atmosphere, you must use Calculation Method 1 as specified in paragraph (c)(1) of this section to calculate vented CH<sub>4</sub> and CO<sub>2</sub> emissions from those pumps. Use Calculation Method 1 for any portion of a year when all of the pumps on the continuously measured natural gas supply line were vented directly to atmosphere. For natural gas driven pneumatic pumps vented directly to the atmosphere for which the natural gas supply rate is not continuously measured or the continuously measured natural gas supply line supplies some natural gas driven pneumatic pumps that vent emissions directly to the atmosphere and others that route emissions to flares, combustion or vapor recovery, use either the method specified in paragraph (c)(2) or (3) of this section to calculate vented CH<sub>4</sub> and CO<sub>2</sub> emissions for all of the natural gas driven pneumatic pumps at your facility that are not subject to Calculation Method 1; you may not use Calculation Method 2 for some vented natural gas driven pneumatic pumps and Calculation Method 3 for other natural gas driven pneumatic pumps. Calculate emissions from natural gas driven pneumatic pumps routed to flares or combustion as specified in paragraph (c)(4) of this section. All references to natural gas driven pneumatic pumps for Calculation Method 1 in this paragraph (c) also apply to combinations of natural gas pneumatic devices and natural gas driven pneumatic pumps that are served by a common natural gas supply line. You do not have to calculate emissions from natural gas driven pneumatic pumps covered in paragraph (e) of this section under this paragraph (c).

(1) **Calculation method 1.** If you have or elect to install a continuous flow meter that is capable of meeting the requirements of § 98.234(b) on a supply line to natural gas driven pneumatic pumps, then for the period of the year when the natural gas supply line is dedicated to any one or more natural gas driven pneumatic pumps, and each of the pumps is vented directly to the atmosphere, you must use the applicable methods specified in paragraph (c)(1)(i) or (ii) of this section to calculate vented CH<sub>4</sub> and CO<sub>2</sub> emissions from those pumps.

(i) For volumetric flow monitors:

- (A) Determine the cumulative annual volumetric flow, in standard cubic feet, as measured by the flow monitor in the reporting year. If the flow meter was installed during the year, calculate the total volumetric flow for the year based on the measured volumetric flow times the total hours in the calendar year in which at least one of the pumps connected to the supply line was pumping liquid divided by the number of hours in the year when at least one of pumps connected to the supply line was pumping liquid and the volumetric flow was being measured.
- (B) Convert the natural gas volumetric flow from paragraph (c)(1)(i)(A) of this section to CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions following the provisions in paragraph (u) of this section.

- (C) Convert the CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions from paragraph (c)(1)(i)(B) of this section to CH<sub>4</sub> and CO<sub>2</sub> mass emissions using calculations in paragraph (v) of this section.
- (ii) For mass flow monitors:
  - (A) Determine the cumulative annual mass flow, in metric tons, as measured by the flow monitor in the reporting year. If the flow meter was installed during the year, calculate the total mass flow of vented natural gas emissions for the year based on the measured mass flow times the total hours in the calendar year in which at least one of the pumps connected to the supply line was pumping liquid divided by the number of hours in the year when at least one of pumps connected to the supply line was pumping liquid and the mass flow was being measured.
  - (B) Convert the cumulative mass flow from paragraph (c)(1)(ii)(A) of this section to CH<sub>4</sub> and CO<sub>2</sub> mass emissions by multiplying by the mass fraction of CH<sub>4</sub> and CO<sub>2</sub> in the supplied natural gas. You must follow the provisions in paragraph (u) of this section for determining the mole fraction of CH<sub>4</sub> and CO<sub>2</sub> and use molecular weights of 16 kg/kg-mol and 44 kg/kg-mol for CH<sub>4</sub> and CO<sub>2</sub>, respectively. You may assume unspecified components have an average molecular weight of 28 kg/kg-mol.
- (iii) If the supply line serves both natural gas pneumatic devices and natural gas driven pneumatic pumps, disaggregate the total measured amount of natural gas to natural gas pneumatic devices and natural gas driven pneumatic pumps based on engineering calculations and best available data.
- (iv) The flow meter must be operated and calibrated according to the methods set forth in § 98.234(b).
- (2) **Calculation Method 2.** Except as provided in paragraph (c)(1) of this section, you may elect to measure the volumetric flow rate of each natural gas driven pneumatic pump at your facility that vents directly to the atmosphere as specified in paragraphs (c)(2)(i) through (vii) of this section. You must exclude the counts of pumps measured according to paragraph (c)(1) of this section from the counts of pumps to be measured and for which emissions are calculated according to the requirements in this paragraph (c)(2).
  - (i) Measure all natural gas driven pneumatic pumps at your facility at least once every 5 years. If you elect to measure your pneumatic pumps over multiple years, you must measure approximately the same number of pumps each year. When you measure the emissions from natural gas driven pneumatic pumps at a well-pad site or gathering and boosting site, you must measure all pneumatic pumps that are vented directly to the atmosphere at the well-pad site or gathering and boosting site during the same calendar year.
  - (ii) Determine the volumetric flow rate of each natural gas driven pneumatic pump (in standard cubic feet per hour) using one of the methods specified in § 98.234(b) through (d), as appropriate, according to the requirements specified in paragraphs (c)(2)(ii)(A) through (D) of this section. You must measure the emissions under conditions representative of normal operations, which excludes periods immediately after conducting maintenance on the pump.
    - (A) If you use a temporary meter, such as a vane anemometer, according to the methods set forth in § 98.234(b) or a high volume sampler according to methods set forth in § 98.234(d), you must measure the emissions from each pump for a minimum of 5 minutes, during a period when the pump is continuously pumping liquid.

- (B) If you use calibrated bagging, follow the methods set forth in § 98.234(c), except under § 98.234(c)(2), only one bag must be filled to have a valid measurement. You must collect sample for a minimum of 5 minutes, or until the bag is full, whichever is shorter, during a period when the pump is continuously pumping liquid. If the bag is not full after 5 minutes, you must either continue sampling until you fill the calibrated bag or you may elect to remeasure the vent according to paragraph (c)(2)(ii)(A) of this section.
  - (C) You do not need to use the same measurement method for each natural gas driven pneumatic pump vent.
  - (D) If the measurement method selected measures the volumetric flow rate in actual cubic feet, convert the measured flow to standard cubic feet following the methods specified in paragraph (t)(1) of this section. Convert the measured flow during the test period to standard cubic feet per hour, as appropriate.
- (iii) Calculate the volume of natural gas emitted from each natural gas driven pneumatic pump vent as the product of the natural gas emissions flow rate measured in paragraph (c)(2)(ii) of this section and the number of hours that liquid was pumped by the pneumatic pump in the calendar year.
  - (iv) For each pneumatic pump, convert the volumetric emissions of natural gas at standard conditions determined in paragraph (c)(2)(iii) of this section to CO<sub>2</sub> and CH<sub>4</sub> volumetric emissions at standard conditions using the methods specified in paragraph (u) of this section.
  - (v) For each pneumatic pump, convert the GHG volumetric emissions at standard conditions determined in paragraph (c)(2)(iv) of this section to GHG mass emissions using the methods specified in paragraph (v) of this section.
  - (vi) Sum the CO<sub>2</sub> and CH<sub>4</sub> mass emissions determined in paragraph (c)(2)(v) of this section.
  - (vii) If you chose to conduct natural gas pneumatic pump measurements over multiple years, “n,” according to paragraph (c)(2)(i) of this section, then you must calculate the emissions from all pneumatic pumps at your facility as specified in paragraph (c)(2)(vii)(A) through (D) of this section.
    - (A) Use the emissions calculated in paragraph (c)(2)(vi) of this section for the pumps measured during the reporting year.
    - (B) Calculate the whole gas emission factor for pneumatic pumps at the facility using equation W-2A to this section and all available data from the current year and the previous years in your monitoring cycle (n-1 years) for which natural gas pneumatic pump vent measurements were made according to Calculation Method 2 in paragraph (c)(2) of this section (e.g., if your monitoring cycle is 3 years, then use measured data from the current year and the two previous years). This emission factor must be updated annually.

$$EF_s = \frac{\sum_{y=1}^n MT_{s,y}}{\sum_{y=1}^n Count_y} \quad (\text{Eq. W-2A})$$

Where:

$EF_s$  = Whole gas population emission factor for natural gas pneumatic pump vents, in standard cubic feet per hour per pump.

$MT_{s,y}$  = Volumetric whole gas emissions rate measurement at standard ("s") conditions during year "y" in standard cubic feet per hour, as calculated in [paragraph \(c\)\(2\)\(iii\)](#) of this section.

$Count_y$  = Count of natural gas driven pneumatic pump vents measured according to Calculation Method 2 in year "y."

n = Number of years of data to include in the emission factor calculation according to the number of years used to monitor all natural gas pneumatic pump vents at the facility.

- (C) Calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions from natural gas driven pneumatic pumps per well-pad site or gathering and boosting site that were not measured during the reporting year using equation W-2B to this section.

$$E_{s,i} = Count \times EF_s \times GHG_i \times T \quad (Eq. W-2B)$$

Where:

$E_{s,i}$  = Annual total volumetric GHG emissions at standard conditions in standard cubic feet per year from natural gas driven pneumatic pump vents, for GHG<sub>i</sub>.

Count = Total number of natural gas driven pneumatic pumps that vented directly to the atmosphere and that were not directly measured according to the requirements in [paragraphs \(c\)\(1\)](#) or [\(c\)\(2\)\(ii\)](#) of this section.

$EF_s$  = Population emission factors for natural gas driven pneumatic pumps (in standard cubic feet per hour per pump) as calculated using equation W-2A to this section.

GHG<sub>i</sub> = Concentration of GHG<sub>i</sub>, CH<sub>4</sub> or CO<sub>2</sub>, in produced natural gas as defined in [paragraph \(u\)\(2\)\(i\)](#) of this section.

T = Average estimated number of hours in the operating year the pumps that vented directly to the atmosphere were pumping liquid using engineering estimates based on best available data. Default is 8,760 hours for pumps that only vented directly to the atmosphere.

- (D) Calculate both CH<sub>4</sub> and CO<sub>2</sub> mass emissions from volumetric emissions calculated using equation W-2B to this section using calculations in [paragraph \(v\)](#) of this section.
- (E) Sum the CH<sub>4</sub> and CO<sub>2</sub> mass emissions calculated in [paragraphs \(c\)\(2\)\(vii\)\(A\)](#) and (D) of this section to calculate the total CH<sub>4</sub> and CO<sub>2</sub> mass emissions for Calculation Method 2 per well-pad site or gathering and boosting site.
- (3) **Calculation Method 3.** If you elect not to measure emissions as specified in Calculation Method 2, then you must use the applicable method specified in [paragraphs \(c\)\(3\)\(i\)](#) and (ii) of this section to calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from all natural gas driven pneumatic pumps that are vented directly to the atmosphere at each well-pad site or gathering and boosting site at your facility and

that are not measured according to paragraph (c)(1) of this section. You must exclude the counts of devices measured according to paragraph (c)(1) of this section from the counts of pumps for which emissions are calculated according to the requirements in this paragraph (c)(3).

- (i) Calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions from natural gas driven pneumatic pumps using equation W-2B to this section, except use the appropriate default whole gas population emission factor for natural gas pneumatic pump vents (in standard cubic feet per hour per device) as provided in table W-1 to this subpart.
- (ii) Convert the CH<sub>4</sub> and CO<sub>2</sub> volumetric emissions determined according to paragraph (c)(3)(i) of this section to CO<sub>2</sub> and CH<sub>4</sub> mass emissions using calculations in paragraph (v) of this section.

(4) **Routing to flares, combustion, or vapor recovery systems.** Calculate emissions from natural gas driven pneumatic pumps for periods when they are routed to flares or combustion as specified in paragraph (c)(4)(i) or (ii) of this section, as applicable. If emissions from a natural gas driven pneumatic pump were vented directly to the atmosphere for part of the year and routed to a flare, combustion, or vapor recovery for another part of the year, then calculate vented emissions for the portion of the year when venting occurs using the applicable method in paragraph (c)(1), (2), or (3) of this section for the period when venting occurs (including periods when emissions bypassed a flare), and calculate emissions for the portion of the year when the emissions are routed to a flare or combustion unit using the method in paragraph (c)(4) of this section. During periods when emissions from a pump are routed to a vapor recovery system without subsequently being routed to combustion, paragraphs (c)(1) through (3) and (c)(4)(i) and (ii) of this section do not apply and no emissions calculations are required. Notwithstanding the calculation and emissions reporting requirements as specified in this paragraph (c)(4) of this section, the number of natural gas pneumatic pumps routed to flares, combustion, or vapor recovery systems must be reported as specified in § 98.236(c)(2)(iii) and (iv).

- (i) If any natural gas driven pneumatic pumps were routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions for the flare stack as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
- (ii) If emissions from any natural gas driven pneumatic pumps were routed to combustion, you must calculate emissions for the combustion equipment as specified in paragraph (z) of this section and report emissions from the combustion equipment as specified in § 98.236(z).

(d) **Acid gas removal unit (AGR) vents and Nitrogen removal unit (NRU) vents.** For AGR vents (including processes such as amine, membrane, molecular sieve or other absorbents and adsorbents), calculate emissions for CH<sub>4</sub> and CO<sub>2</sub> vented directly to the atmosphere or emitted through a sulfur recovery plant, using any of the calculation methods described in paragraphs (d)(1) through (4) of this section, and also comply with paragraphs (d)(5) through (12) of this section, as applicable. For NRU vents, calculate emissions for CH<sub>4</sub> vented directly to the atmosphere using any of the calculation methods described in paragraphs (d)(1) through (4) of this section, and also comply with paragraphs (d)(5) through (12) of this section, as applicable. If any AGR vents or NRU vents are routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions for the flare stack as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n). If any AGR vents or NRU vents are routed through an engine (e.g., permeate from a membrane or de-adsorbed gas from a pressure swing adsorber used as fuel supplement) (i.e., routed to combustion), you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions as specified in subpart C of this part or as specified in paragraph (z) of this section, as applicable.

- (1) **Calculation Method 1.** If you operate and maintain a continuous emissions monitoring system (CEMS) that has both a CO<sub>2</sub> concentration monitor and volumetric flow rate monitor, you must calculate CO<sub>2</sub> emissions under this subpart by following the Tier 4 Calculation Method and all associated calculation, quality assurance, reporting, and recordkeeping requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources). Alternatively, you may follow the manufacturer's instructions or industry standard practice. If a CO<sub>2</sub> concentration monitor and volumetric flow rate monitor are not available, you may elect to install a CO<sub>2</sub> concentration monitor and a volumetric flow rate monitor that comply with all of the requirements specified for the Tier 4 Calculation Method in subpart C of this part (General Stationary Fuel Combustion Sources).
- (2) **Calculation Method 2.** Except as specified in paragraph (d)(4) of this section, for CO<sub>2</sub> emissions, if a CEMS is not available but a vent meter is installed, use the CO<sub>2</sub> composition and annual volume of vent gas to calculate emissions using equation W-3 to this section. Except as specified in paragraph (d)(4) of this section, for CH<sub>4</sub> emissions, if a vent meter is installed, including the volumetric flow rate monitor on a CEMS for CO<sub>2</sub>, use the CH<sub>4</sub> composition and annual volume of vent gas to calculate emissions using equation W-3 to this section.

$$E_{a,i} = V_a \times Vol_i \quad (\text{Eq. W-3})$$

Where:

$E_{a,i}$  = Annual total volumetric GHGi (either CO<sub>2</sub> or CH<sub>4</sub>) emissions at actual conditions, in cubic feet per year.

$V_a$  = Total annual volume of vent gas flowing out of the AGR or NRU in cubic feet per year at actual conditions as determined by flow meter using methods set forth in § 98.234(b). Alternatively, you may follow the manufacturer's instructions or industry standard practice for calibration of the vent meter.

$Vol_i$  = Annual average volumetric fraction of GHGi (either CO<sub>2</sub> or CH<sub>4</sub>) content in vent gas flowing out of the AGR or NRU as determined in paragraph (d)(7) of this section.

- (3) **Calculation Method 3.** If a CEMS for CO<sub>2</sub> or a vent meter is not installed, you may use the inlet and/or outlet gas flow rate of the AGR or NRU to calculate emissions for CH<sub>4</sub> and CO<sub>2</sub> using equation W-4A, W-4B, or W-4C to this section. If inlet gas flow rate and CH<sub>4</sub> and CO<sub>2</sub> content of the vent gas are known, use equation W-4A to this section. If outlet gas flow rate and CH<sub>4</sub> and CO<sub>2</sub> content of the vent gas are known, use equation W-4B to this section. If inlet gas flow rate and outlet gas flow rate are known, use equation W-4C to this section. If the calculated annual total volumetric emissions ( $E_{a,i}$ ) are less than or equal to 0 cubic feet per year, you may not use this calculation method for either CH<sub>4</sub> or CO<sub>2</sub>.

$$E_{a,i} = V_{in} \times \left[ \frac{Vol_{I,i} - Vol_{O,i}}{Vol_{EM,i} - Vol_{O,i}} \right] \times Vol_{EM,i} \quad (\text{Eq. W-4A})$$

$$E_{a,i} = V_{out} \times \left[ \frac{Vol_{I,i} - Vol_{O,i}}{Vol_{EM,i} - Vol_{I,i}} \right] \times Vol_{EM,i} \quad (\text{Eq. W-4B})$$

$$E_{a,i} = (V_{in} \times Vol_{I,i}) - (V_{out} \times Vol_{O,i}) \quad (\text{Eq. W-4C})$$

Where:

$E_{a,i}$  = Annual total volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions at actual conditions, in cubic feet per year.

$V_{in}$  = Total annual volume of natural gas flow into the AGR or NRU in cubic feet per year at actual conditions as determined using methods specified in paragraph (d)(5) of this section.

$V_{out}$  = Total annual volume of natural gas flow out of the AGR or NRU in cubic feet per year at actual conditions as determined using methods specified in paragraph (d)(5) of this section.

$Vol_{I,i}$  = Annual average volumetric fraction of GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) content in natural gas flowing into the AGR or NRU as determined in paragraph (d)(7) of this section.

$Vol_{O,i}$  = Annual average volumetric fraction of GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) content in natural gas flowing out of the AGR or NRU as determined in paragraph (d)(8) of this section.

$Vol_{EM,i}$  = Annual average volumetric fraction of GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) content in the vent gas flowing out of the AGR or NRU as determined in paragraph (d)(6) of this section.

(4) **Calculation Method 4.** If CEMS for CO<sub>2</sub> or a vent meter is not installed, you may calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from an AGR or NRU using any standard simulation software package, such as AspenTech HYSYS®, or API 4679 AMINECalc, that uses the Peng-Robinson equation of state and speciates CH<sub>4</sub> and CO<sub>2</sub> emissions. A minimum of the parameters listed in paragraph (d)(4)(i) through (x) of this section, as applicable, must be used to characterize emissions. If paragraph (d)(4)(i) through (x) of this section indicates that an applicable parameter must be measured, collect measurements reflective of representative operating conditions over the time period covered by the simulation. Determine all other applicable parameters in paragraph (d)(4)(i) through (x) of this section by engineering estimate and process knowledge based on best available data and, if necessary, adjust parameters to represent the operating conditions over the time period covered by the simulation. Determine the number of simulations and associated time periods such that the simulations cover the entire reporting year (i.e., if you calculate emissions using one simulation, use representative parameters for the operating conditions over the calendar year; if you use periodic simulations to cover the calendar year, use parameters for the operating conditions over each corresponding appropriate portion of the calendar year). You may also use this method for CO<sub>2</sub> emissions from an AGR if a vent meter is installed but a CEMS is not, or for CH<sub>4</sub> emissions from an AGR if a vent meter is installed (including the volumetric flow rate monitor on a CEMS for CO<sub>2</sub>), in which case you must determine the difference between the annual volume of vent gas measured by the vent meter and the simulated annual volume of vent gas according to paragraph (d)(9) of this section.

- (i) Natural gas feed temperature, pressure, and flow rate (must be measured).
- (ii) Acid gas content of feed natural gas (must be measured).
- (iii) Acid gas content of outlet natural gas.
- (iv) CH<sub>4</sub> content of feed natural gas (must be measured).
- (v) CH<sub>4</sub> content of outlet natural gas.
- (vi) For NRU, nitrogen content of feed natural gas (must be measured).
- (vii) For NRU, nitrogen content of outlet natural gas.



- (viii) Unit operating hours, excluding downtime for maintenance or standby.
  - (ix) Exit temperature of natural gas.
  - (x) For AGR, solvent type, pressure, temperature, circulation rate, and composition.
- (5) **Flow rate of inlet or outlet.** For Calculation Method 3, determine the gas flow rate of the inlet when using equation W-4A or W-4C to this section or the gas flow rate of the outlet when using equation W-4B or W-4C to this section for the natural gas stream of an AGR or NRU using a meter according to methods set forth in § 98.234(b). If you do not have a continuous flow meter, either install a continuous flow meter or use an engineering calculation to determine the flow rate.
- (6) **Composition of vent gas.** For Calculation Method 2 or Calculation Method 3 when using equation W-4A or W-4B to this section, if a continuous gas analyzer is not available on the vent stack, either install a continuous gas analyzer or take quarterly gas samples from the vent gas stream for each quarter that the AGR or NRU is operating to determine  $Vol_i$  in equation W-3 to this section or  $Vol_{EM,i}$  in equation W-4A or W-4B to this section, according to the methods set forth in § 98.234(b).
- (7) **Composition of inlet gas stream.** For Calculation Method 3, if a continuous gas analyzer is installed on the inlet gas stream, then the continuous gas analyzer results must be used. If a continuous gas analyzer is not available, either install a continuous gas analyzer or take quarterly gas samples from the inlet gas stream for each quarter that the AGR or NRU is operating to determine  $Vol_{I,i}$  in equation W-4A, W-4B, or W-4C to this section, according to the methods set forth in § 98.234(b).
- (8) **Composition of outlet gas stream.** For Calculation Method 3, determine annual average volumetric fraction of GHGi (either CH<sub>4</sub> or CO<sub>2</sub>) content in natural gas flowing out of the AGR or NRU using one of the methods specified in paragraphs (d)(8)(i) through (iii) of this section.
- (i) If a continuous gas analyzer is installed on the outlet natural gas stream, then the continuous gas analyzer results must be used. If a continuous gas analyzer is not available, you may install a continuous gas analyzer.
  - (ii) If a continuous gas analyzer is not available or installed, quarterly gas samples may be taken from the outlet natural gas stream for each quarter that the AGR or NRU is operating to determine  $Vol_{O,i}$  in equation W-4A, W-4B, or W-4C to this section, according to the methods set forth in § 98.234(b).
  - (iii) If a continuous gas analyzer is not available or installed, you may use the outlet pipeline quality specification for CO<sub>2</sub> in natural gas and the outlet quality specification for CH<sub>4</sub> in natural gas.
- (9) **Comparison of annual volume of vent gas.** If a vent meter is installed but you wish to use Calculation Method 4 rather than Calculation Method 2 for an AGR, use equation W-4D to this section to determine the difference between the annual volume of vent gas measured by the vent meter and the simulated annual volume of vent gas.

$$PD = \frac{|V_{a,meter} - V_{a,sim}|}{\left(\frac{V_{a,meter} + V_{a,sim}}{2}\right)} \times 100\% \quad (\text{Eq. W-4D})$$

Where:

PD = Percent difference between vent gas volumes, %.



$V_{a, \text{meter}}$  = Total annual volume of vent gas flowing out of the AGR in cubic feet per year at actual conditions as determined by flow meter using methods set forth in § 98.234(b). Alternatively, you may follow the manufacturer's instructions or industry standard practice for calibration of the vent meter.

$V_{a, \text{sim}}$  = Total annual volume of vent gas flowing out of the AGR in cubic feet per year at actual conditions as determined by a standard simulation software package consistent with paragraph (d)(4) of this section.

- (10) **Volumetric emissions.** Calculate annual volumetric CH<sub>4</sub> and CO<sub>2</sub> emissions at standard conditions using calculations in paragraph (t) of this section.
- (11) **Emissions vented directly to atmosphere from AGRs or NRUs routed to vapor recovery systems or flares.** If the AGR vent or NRU vent has a vapor recovery system or routes emissions to a flare, calculate annual emissions vented directly to atmosphere from the AGR vent or NRU vent during periods of time when emissions were not routed to the vapor recovery system or flare as specified in paragraph (d)(11)(i) and (ii) of this section. If emissions are routed to a flare but the flare is unlit, calculate emissions in accordance with the methodology specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
  - (i) Calculate vented emissions as specified in paragraph (d)(1), (2), (3), or (4) of this section, which represents the emissions from the AGR vent or NRU vent prior to the vapor recovery system or flare. Calculate an average hourly vented emissions rate by dividing the vented emissions by the number of hours that the AGR or NRU was in operation.
  - (ii) To calculate vented emissions during periods when the AGR vent or NRU vent was not routing emissions to a vapor recovery system or a flare, multiply the average hourly vented emissions rate determined in paragraph (d)(11)(i) of this section by the number of hours that the AGR or NRU vented directly to the atmosphere. Determine the number of hours that the AGR or NRU vented directly to atmosphere by subtracting the hours that the AGR or NRU was connected to a vapor recovery system or flare (based on engineering estimate and best available data) from the total operating hours for the AGR or NRU in the calendar year. You must take into account periods with reduced capture efficiency of the vapor recovery system or flare.
- (12) **Mass emissions.** Calculate annual mass CH<sub>4</sub> and CO<sub>2</sub> emissions using calculations in paragraph (v) of this section.
- (e) **Dehydrator vents.** For dehydrator vents, calculate annual CH<sub>4</sub> and CO<sub>2</sub> emissions using the applicable calculation methods described in paragraphs (e)(1) through (5) of this section. For glycol dehydrators that have an annual average daily natural gas throughput that is greater than or equal to 0.4 million standard cubic feet per day, use Calculation Method 1 in paragraph (e)(1) of this section. For glycol dehydrators that have an annual average of daily natural gas throughput that is greater than 0 million standard cubic feet per day and less than 0.4 million standard cubic feet per day, use either Calculation Method 1 in paragraph (e)(1) of this section or Calculation Method 2 in paragraph (e)(2) of this section. If you are required to use a software program consistent with the requirements of paragraph (e)(1) of this section for compliance with Federal or state regulations, air permit requirements, or annual emissions inventory reporting for the current reporting year, you must use Calculation Method 1 to calculate annual CH<sub>4</sub> and CO<sub>2</sub> emissions. If emissions from dehydrator vents are routed to a vapor recovery system, you must calculate the emissions according to paragraph (e)(4) of this section. If emissions from dehydrator vents are routed to a regenerator firebox/fire tubes or to other non-flare combustion units, you must calculate

CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O annual emissions as specified in paragraph (e)(5) of this section. If any dehydrator vents are routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions for the flare stack as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).

(1) **Calculation Method 1.** Calculate annual mass emissions from glycol dehydrators by using a software program, such as AspenTech HYSYS®, Bryan Research & Engineering ProMax®, or GRI-GLYCalc™, that uses the Peng-Robinson equation of state to calculate the equilibrium coefficient, speciates CH<sub>4</sub> and CO<sub>2</sub> emissions from dehydrators, and has provisions to include regenerator control devices, a separator flash tank, stripping gas, and a gas injection pump or gas assist pump. If you elect to use ProMax®, you must use version 5.0 or above. Emissions must be modeled from both the still vent and, if applicable, the flash tank vent. A minimum of the parameters listed in paragraph (e)(1)(i) through (xi) of this section, as applicable, must be used to characterize emissions. If paragraph (e)(1)(i) through (xi) of this section indicates that an applicable parameter must be measured, collect measurements reflective of representative operating conditions for the time period covered by the simulation. Sample and analyze composition at least once every five years. Samples must be collected within six months of the startup or by January 1, 2030, whichever date is later. Until such a time that a sample is collected, determine composition by using one of the existing methods. Determine all other applicable parameters in paragraph (e)(1)(i) through (xi) of this section by engineering estimate and process knowledge based on best available data and, if necessary, adjust parameters to represent the operating conditions over the time period covered by the simulation. Determine the number of simulations and associated time periods such that the simulations cover the entire reporting year (i.e., if you calculate emissions using one simulation, use representative parameters for the operating conditions over the calendar year; if you use periodic simulations to cover the calendar year, use parameters for the operating conditions over each corresponding appropriate portion of the calendar year). If more than one simulation is performed, input parameters should be remeasured if no longer representative of operating conditions.

- (i) Feed natural gas flow rate (based on measured data).
- (ii) Feed natural gas water content (must be measured).
- (iii) Outlet natural gas water content.
- (iv) Absorbent circulation pump type (e.g., natural gas pneumatic/air pneumatic/electric).
- (v) Absorbent circulation rate.
- (vi) Absorbent type (e.g., triethylene glycol (TEG), diethylene glycol (DEG) or ethylene glycol (EG)).
- (vii) Use of stripping gas.
- (viii) Use of flash tank separator (and disposition of recovered gas).
- (ix) Hours operated.
- (x) Wet natural gas temperature and pressure at the absorber inlet (must be measured).
- (xi) Wet natural gas composition. Measure this parameter using one of the methods described in paragraphs (e)(1)(xi)(A) and (B) of this section.
  - (A) Use an appropriate standard method published by a consensus-based standards organization if such a method exists or you may use an industry standard practice as specified in § 98.234(b) to sample and analyze wet natural gas composition.

(B) If only composition data for dry natural gas is available, assume the wet natural gas is saturated.

- (2) **Calculation Method 2.** Calculate annual volumetric emissions from glycol dehydrators using equation W-5 to this section, and then calculate the collective CH<sub>4</sub> and CO<sub>2</sub> mass emissions from the volumetric emissions using the procedures in paragraph (v) of this section:

$$E_{s,i} = EF_i * Count * 1000 \quad (\text{Eq. W-5})$$

Where:

$E_{s,i}$  = Annual total volumetric GHG emissions (either CO<sub>2</sub> or CH<sub>4</sub>) at standard conditions in cubic feet.

$EF_i$  = Population emission factors for glycol dehydrators in thousand standard cubic feet per dehydrator per year. Use 73.4 for CH<sub>4</sub> and 3.21 for CO<sub>2</sub> at 60 °F and 14.7 psia.

Count = Total number of glycol dehydrators that have an annual average daily natural gas throughput that is greater than 0 million standard cubic feet per day and less than 0.4 million standard cubic feet per day for which you elect to use this Calculation Method 2.

1000 = Conversion of  $EF_i$  in thousand standard cubic feet to standard cubic feet.

- (3) **Calculation Method 3.** For dehydrators of any size that use desiccant, you must calculate emissions from the amount of gas vented from the vessel when it is depressurized for the desiccant refilling process using equation W-6 to this section. From volumetric natural gas emissions, calculate both CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions using the procedures in paragraphs (u) and (v) of this section. Desiccant dehydrator emissions covered in this paragraph do not have to be calculated separately using the method specified in paragraph (i) of this section for blowdown vent stacks.

$$E_{s,n} = \frac{(H * D^2 * \pi * P_2 * \%G * N)}{(4 * P_1 * 100)} \quad (\text{Eq. W-6})$$

Where:

$E_{s,n}$  = Annual natural gas emissions at standard conditions in cubic feet.

H = Height of the dehydrator vessel (ft).

D = Inside diameter of the vessel (ft).

$P_1$  = Atmospheric pressure (psia).

$P_2$  = Pressure of the gas (psia).

$\pi$  = pi (3.14).

%G = Percent of packed vessel volume that is gas.

N = Number of dehydrator openings in the calendar year.

100 = Conversion of %G to fraction.

- (4) ***Emissions vented directly to atmosphere from dehydrators routed to a vapor recovery system, flare, or regenerator firebox/fire tubes.*** If the dehydrator(s) has a vapor recovery system, routes emissions to a flare, or routes emissions to a regenerator firebox/fire tubes and you use Calculation Method 1 or Calculation Method 2 in paragraph (e)(1) or (2) of this section, calculate annual emissions vented directly to atmosphere from the dehydrator(s) during periods of time when emissions were not routed to the vapor recovery system, flare, or regenerator firebox/fire tubes as specified in paragraphs (e)(4)(i) and (ii) of this section. If the dehydrator(s) has a vapor recovery system or routes emissions to a flare or other non-flare combustion unit and you use Calculation Method 3 in paragraph (e)(3) of this section, calculate annual emissions vented directly to atmosphere from the dehydrator(s) during periods of time when emissions were not routed to the vapor recovery system, flare, or other non-flare combustion unit as specified in paragraph (e)(4)(iii) of this section.
- (i) When emissions from dehydrator(s) are calculated using Calculation Method 1 or 2, calculate vented emissions as specified in paragraph (e)(1) or (2) of this section, which represents the emissions from the dehydrator prior to the vapor recovery system, flare, or regenerator firebox/fire tubes. Calculate an average hourly vented emissions rate by dividing the vented emissions by the number of hours that the dehydrator was in operation.
- (ii) To calculate total emissions vented directly to atmosphere during periods when the dehydrator was not routing emissions to a vapor recovery system, flare, or regenerator firebox/fire tubes for dehydrator(s) with emissions calculated using Calculation Method 1 or 2, multiply the average hourly vented emissions rate determined in paragraph (e)(4)(i) of this section by the number of hours that the dehydrator vented directly to the atmosphere. Determine the number of hours that the dehydrator vented directly to atmosphere by subtracting the hours that the dehydrator was connected to a vapor recovery system, flare, or regenerator firebox/fire tubes (based on engineering estimate and best available data) from the total operating hours for the dehydrator in the calendar year. You must take into account periods with reduced capture efficiency of the vapor recovery system, flare, or regenerator firebox/fire tubes. If emissions are routed to a flare but the flare is unlit, calculate emissions in accordance with the methodology specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
- (iii) When emissions from dehydrator(s) are calculated using Calculation Method 3, calculate total annual emissions vented directly to atmosphere from the dehydrator(s) during periods of time when emissions were not routed to the vapor recovery system, flare, or other non-flare combustion unit by determining of the number of depressurization events (including portions of an event) that vented to atmosphere based on engineering estimate and best available data. You must take into account periods with reduced capture efficiency of the vapor recovery system, flare, or other non-flare combustion unit. If emissions are routed to a flare but the flare is unlit, calculate emissions in accordance with the methodology specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
- (5) ***Combustion emissions from routing to regenerator firebox/fire tubes or other non-flare combustion unit.*** If any glycol dehydrator emissions are routed to a regenerator firebox/fire tubes, calculate emissions from these devices attributable to dehydrator flash tank vents or still vents as specified in paragraphs (e)(5)(i) through (iii) of this section. If any desiccant dehydrator emissions are routed to

a non-flare combustion unit, calculate combusted emissions as specified in paragraphs (e)(5)(i) through (iii) of this section. If you operate a CEMS to monitor the emissions from the regenerator firebox/fire tubes or other non-flare combustion unit, calculate emissions as specified in paragraph (e)(5)(iv) of this section.

- (i) Determine the volume of the total emissions that is routed to a regenerator firebox/fire tubes or other non-flare combustion unit as specified in paragraph (e)(5)(i)(A) or (B) of this section.
    - (A) Measure the flow from the dehydrator(s) to the regenerator firebox/fire tubes or other non-flare combustion unit using a continuous flow measurement device. If you continuously measure flow to the regenerator firebox/fire tubes or other non-flare combustion unit, you must use the measured volumes to calculate emissions from the regenerator firebox/fire tubes or other non-flare combustion unit.
    - (B) Using engineering estimates based on best available data, determine the volume of the total emissions estimated in paragraph (e)(1), (2), or (3) of this section, as applicable, that is routed to the regenerator firebox/fire tubes or other non-flare combustion unit.
  - (ii) Determine composition of the gas routed to a regenerator firebox/fire tubes or other non-flare combustion unit as specified in paragraph (e)(5)(ii)(A) or (B) of this section.
    - (A) Use the appropriate vent emissions as determined in paragraph (e)(1) or (2) of this section.
    - (B) Measure the composition of the gas from the dehydrator(s) to the regenerator firebox/fire tubes or other non-flare combustion unit using a continuous composition analyzer. If you continuously measure gas composition, then those measured data must be used to calculate dehydrator emissions from the regenerator firebox/fire tubes or other non-flare combustion unit.
  - (iii) Determine GHG volumetric emissions at actual conditions from the regenerator firebox/fire tubes or other non-flare combustion unit using equations W-39A, W-39B, and W-40 to this section. Calculate GHG volumetric emissions at standard conditions using calculations in paragraph (t) of this section. Calculate both GHG mass emissions from volumetric emissions using calculations in paragraph (v) of this section.
  - (iv) If you operate and maintain a CEMS that has both a CO<sub>2</sub> concentration monitor and volumetric flow rate monitor for the combustion gases from the regenerator firebox/fire tubes or other non-flare combustion unit, you must calculate only CO<sub>2</sub> emissions for the regenerator firebox/fire tubes or other non-flare combustion unit. You must follow the Tier 4 Calculation Method and all associated calculation, quality assurance, reporting, and recordkeeping requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources). If a CEMS is used to calculate emissions from a regenerator firebox/fire tubes or other non-flare combustion unit, the requirements specified in paragraphs (e)(5)(ii) and (iii) of this section are not required.
- (f) **Well venting for liquids unloadings.** Calculate annual volumetric natural gas emissions from well venting for liquids unloading when the well is unloaded to the atmosphere using one of the calculation methods described in paragraph (f)(1), (2), or (3) of this section. Calculate annual CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions using the method described in paragraph (f)(4) of this section. If emissions from well venting for liquids unloading are routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O annual emissions as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).

- (1) **Calculation Method 1.** Calculate emissions from manual and automated unloadings at wells with plunger lifts and wells without plunger lifts separately. For at least one well of each unique well tubing diameter group and pressure group combination in each sub-basin category (see § 98.238 for the definitions of tubing diameter group, pressure group, and sub-basin category), where gas wells are vented directly to the atmosphere to expel liquids accumulated in the tubing, install a recording flow meter on the vent line used to vent gas from the well (e.g., on the vent line off the wellhead separator or atmospheric storage tank) according to methods set forth in § 98.234(b). Calculate the total emissions from well venting to the atmosphere for liquids unloading using equation W-7A to this section. Equation W-7A to this section must be used for each unloading type combination (automated plunger lift unloadings, manual plunger lift unloadings, automated unloadings without plunger lifts and manual unloadings without plunger lifts) for any tubing diameter group and pressure group combination in each sub-basin.

$$E_a = FR \times T_p \quad (\text{Eq. W-7A})$$

Where:

$E_a$  = Annual natural gas emissions for each well of the same tubing diameter group and pressure group combination in the sub-basin at actual conditions, a, in cubic feet. Calculate emissions from wells with automated plunger lift unloadings, wells with manual plunger lift unloadings, wells with automated unloadings without plunger lifts and wells with manual unloadings without plunger lifts separately.

FR = Average flow rate in cubic feet per hour for all measured wells of the same tubing diameter group and pressure group combination in a sub-basin, over the duration of the liquids unloading, under actual conditions as determined in paragraph (f)(1)(i) of this section.

$T_p$  = Cumulative amount of time in hours of venting for each well, p, of the same tubing diameter group and pressure group combination in a sub-basin during the year. If the available venting data do not contain a record of the date of the venting events and data are not available to provide the venting hours for the specific time period of January 1 to December 31, you may calculate an annualized vent time,  $T_p$ , using equation W-7B to this section.

$$T_p = \frac{HR_p}{MP_p} \times D_p \quad (\text{Eq. W-7B})$$

Where:

$HR_p$  = Cumulative amount of time in hours of venting for each well, p, during the monitoring period.

$MP_p$  = Time period, in days, of the monitoring period for each well, p. A minimum of 300 days in a calendar year are required. The next period of data collection must start immediately following the end of data collection for the previous reporting year.

$D_p$  = Time period, in days during which the well, p, was in production (365 if the well was in production for the entire year).

- (i) Determine the well vent average flow rate ("FR" in equation W-7A to this section) as specified in paragraphs (f)(1)(i)(A) through (C) of this section for at least one well in a unique well tubing diameter group and pressure group combination in each sub-basin category. Calculate emissions from wells with automated plunger lift unloadings, wells with manual plunger lift unloadings, wells with automated unloadings without plunger lifts and wells with manual unloadings without plunger lifts separately.
  - (A) Calculate the average flow rate per hour of venting for each unique tubing diameter group and pressure group combination in each sub-basin category by dividing the recorded total annual flow by the recorded time (in hours) for all measured liquid unloading events with venting to the atmosphere.
  - (B) Apply the average hourly flow rate calculated under paragraph (f)(1)(i)(A) of this section to each well in the same pressure group that have the same tubing diameter group, for the number of hours that each well is vented to the atmosphere.
  - (C) Calculate a new average flow rate every other calendar year starting with the first calendar year of data collection. For a new producing sub-basin category, calculate an average flow rate beginning in the first year of production.
- (ii) Calculate natural gas volumetric emissions at standard conditions using calculations in paragraph (t) of this section.
- (2) **Calculation Method 2.** Calculate the total emissions for each well from manual and automated well venting to the atmosphere for liquids unloading without plunger lift assist using equation W-8 to this section.

$$E_s = N_p \times \left( (0.37 \times 10^{-3}) \times CD_p^2 \times WD_p \times SP_p \right) + \sum_{q=1}^{N_p} (SFR_p \times (HR_{p,q} - 1.0) \times Z_{p,q}) \text{ (Eq. W-8)}$$

Where:

$E_s$  = Annual natural gas emissions for each well at standard conditions, s, in cubic feet per year

$N_p$  = Total number of unloading events in the monitoring period per well, p.

$0.37 \times 10^{-3} = \{3.14 (\pi)/4\} / \{14.7 \times 144\}$  (psia converted to pounds per square feet).

$CD_p$  = Casing internal diameter for well, p, in inches or the tubing diameter for well, p, when stoppage packers are used in the annulus to restrict flow of gas up the annulus to the surface.

$WD_p$  = Vertical well depth from either the top of the well or the lowest packer to the bottom of the well or the top of the fluid column, for well, p, in feet. For horizontal wells the bottom of the well is the point at which the vertical borehole pivots to a horizontal direction.

$SP_p$  = For well, p, shut-in pressure or surface pressure for wells with tubing production, or casing pressure for each well with no packers, in pounds per square inch absolute (psia). If casing pressure is not available for the well, you may determine the casing pressure by multiplying the tubing pressure of the well with a ratio of casing pressure to tubing pressure from a well in the same sub-basin for which the casing pressure is known. The



tubing pressure must be measured during gas flow to a flow-line. The shut-in pressure, surface pressure, or casing pressure must be determined just prior to liquids unloading when the well production is impeded by liquids loading or closed to the flow-line by surface valves.

$SFR_p$  = Average flow-line rate of gas for well, p, at standard conditions in cubic feet per hour. Use equation W-33 to this section to calculate the average flow-line rate at standard conditions.

$HR_{p,q}$  = Hours that well, p, was left open to the atmosphere during each unloading event, q.

1.0 = Hours for average well to blowdown casing volume at shut-in pressure.

q = Unloading event.

$Z_{p,q}$  = If  $HR_{p,q}$  is less than 1.0 then  $Z_{p,q}$  is equal to 0. If  $HR_{p,q}$  is greater than or equal to 1.0 then  $Z_{p,q}$  is equal to 1.

- (3) Calculation Method 3. Calculate the total emissions for each sub-basin from well venting to the atmosphere for liquids unloading with plunger lift assist using equation W-9 to this section.

$$E_s = N_p \times \left( (0.37 \times 10^{-3}) \times TD_p^2 \times WD_p \times SP_p \right) + \sum_{q=1}^{N_p} (SFR_p \times (HR_{p,q} - 0.5) \times Z_{p,q}) \quad (\text{Eq. W-9})$$

Where:

$E_s$  = Annual natural gas emissions for each well at standard conditions, s, in cubic feet per year.

$N_p$  = Total number of unloading events in the monitoring period per well, p.

$0.37 \times 10^{-3} = \{3.14 (\pi)/4\} / \{14.7 \times 144\}$  (psia converted to pounds per square feet).

$TD_p$  = Tubing internal diameter for well, p, in inches.

$WD_p$  = Tubing depth to plunger bumper or to the top of the fluid column for well, p, in feet.

$SP_p$  = Flow-line pressure for well p in pounds per square inch absolute (psia), using engineering estimate based on best available data.

$SFR_p$  = Average flow-line rate of gas for well, p, at standard conditions in cubic feet per hour. Use equation W-33 to this section to calculate the average flow-line rate at standard conditions.

$HR_{p,q}$  = Hours that well, p, was left open to the atmosphere during each unloading event, q.

0.5 = Hours for average well to blowdown tubing volume at flow-line pressure.

q = Unloading event.



$Z_{p,q}$  = If  $HR_{p,q}$  is less than 0.5 then  $Z_{p,q}$  is equal to 0. If  $HR_{p,q}$  is greater than or equal to 0.5 then  $Z_{p,q}$  is equal to 1.

(4) **Volumetric and mass emissions.** Calculate  $CH_4$  and  $CO_2$  volumetric and mass emissions from volumetric natural gas emissions using calculations in paragraphs (u) and (v) of this section.

(g) **Well venting during completions and workovers with hydraulic fracturing.** Calculate annual volumetric natural gas emissions from gas well and oil well venting during completions and workovers involving hydraulic fracturing using equation W-10A or equation W-10B to this section. Equation W-10A to this section applies to well venting when the gas flowback rate is measured from a specified number of example completions or workovers in a sub-basin and well type combination and equation W-10B to this section applies when the gas flowback vent volume is measured for each completion or workover in a sub-basin and well type combination. Completion and workover activities are separated into two periods, an initial period when flowback is routed to open pits or tanks and a subsequent period when gas content is sufficient to route the flowback to a separator or when the gas content is sufficient to allow measurement by the devices specified in paragraph (g)(1) of this section, regardless of whether a separator is actually utilized. If you elect to use equation W-10A to this section, you must follow the procedures specified in paragraph (g)(1) of this section. If you elect to use equation W-10B to this section, you must use a recording flow meter installed on the vent line, downstream of a separator and ahead of a flare or vent, to measure the gas flowback. To calculate emissions during the initial period, you must calculate the gas flowback rate in the initial flowback period as described in equation W-10B to this section. Alternatively, you may use a multiphase flow meter placed on the flow line downstream of the wellhead and ahead of the separator to directly measure gas flowback during the initial period when flowback is routed to open pits or tanks. If you use a multiphase flow meter, measurements must be taken from initiation of flowback to the beginning of the period of time when sufficient quantities of gas are present to enable separation. For either equation, emissions must be calculated separately for completions and workovers, for each sub-basin, and for each well type combination identified in paragraph (g)(2) of this section. You must calculate  $CH_4$  and  $CO_2$  volumetric and mass emissions as specified in paragraph (g)(3) of this section. If emissions from well venting during completions and workovers with hydraulic fracturing are routed to a flare, you must calculate  $CH_4$ ,  $CO_2$ , and  $N_2O$  annual emissions as specified in paragraph (n) of this section, report emissions from the flare as specified in § 98.236(n), and report additional information specified in § 98.236(g), as applicable.

$$E_{s,n} = \sum_{p=1}^{CW} [T_{p,s} \times FRM_s \times PR_{s,p} - EnF_{s,p} + [T_{p,i} \times FRM_i \times Z_{p,i} \times PR_{s,p}]] \quad (\text{Eq. W-10A})$$

$$E_{s,n} = \sum_{p=1}^{CW} [FV_{s,p} - EnF_{s,p} + [T_{p,i} \times FR_{p,i} \times Z_{p,i}]] \quad (\text{Eq. W-10B})$$

Where:

$E_{s,n}$  = Annual volumetric natural gas emissions in standard cubic feet from gas venting during well completions or workovers following hydraulic fracturing for each well.

CW = Total number of completions or workovers using hydraulic fracturing.

$T_{p,s}$  = Cumulative amount of time of flowback, after sufficient quantities of gas are present to enable separation, where gas vented for each completion or workover, in hours, during the reporting year. This may include non-contiguous periods of venting.

$T_{p,i}$  = Cumulative amount of time of flowback to open tanks/pits, from when gas is first detected until sufficient quantities of gas are present to enable separation, for each completion or workover, in hours, during the reporting year. This may include non-contiguous periods of routing to open tanks/pits but does not include periods when the oil well ceases to produce fluids to the surface.

$FRM_s$  = Ratio of average gas flowback, during the period when sufficient quantities of gas are present to enable separation, of well completions and workovers from hydraulic fracturing to 30-day production rate for the sub-basin and well type combination, calculated using procedures specified in paragraph (g)(1)(iii) of this section.

$FRM_i$  = Ratio of initial gas flowback rate during well completions and workovers from hydraulic fracturing to 30-day gas production rate for the sub-basin and well type combination, calculated using procedures specified in paragraph (g)(1)(iv) of this section, for the period of flow to open tanks/pits.

$PR_{s,p}$  = Average gas production flow rate during the first 30 days of production after each completion of a newly drilled well or well workover using hydraulic fracturing in standard cubic feet per hour that was measured in the sub-basin and well type combination. If applicable,  $PR_{s,p}$  may be calculated for oil wells using procedures specified in paragraph (g)(1)(vii) of this section.

$EnF_{s,p}$  = Volume of N<sub>2</sub> injected gas in cubic feet at standard conditions that was injected into the reservoir during an energized fracture job or during flowback during each completion or workover, as determined by using an appropriate meter according to methods described in § 98.234(b), or by using receipts of gas purchases that are used for the energized fracture job or injection during flowback. Convert to standard conditions using paragraph (t) of this section. If the fracture process did not inject gas into the reservoir or if the injected gas is CO<sub>2</sub> then  $EnF_{s,p}$  is 0.

$FV_{s,p}$  = Flow volume of vented gas for each completion or workover, in standard cubic feet measured using a recording flow meter (digital or analog) on the vent line to measure gas flowback during the separation period of the completion or workover according to methods set forth in § 98.234(b).

$FR_{p,i}$  = Flow rate vented of each completion or workover, in standard cubic feet per hour during the initial period when flowback is routed to open pits or tanks from initiation of flowback to the beginning of the period of time when sufficient quantities of gas are present to enable separation, measured using a recording flow meter (digital or analog) on the vent line to measure the flowback, at the beginning of the period of time when sufficient quantities of gas are present to enable separation, of the completion or workover according to methods set forth in § 98.234(b). Alternatively, flow rate during the initial period may be measured using a multiphase flow meter installed upstream of the separator capable of accurately measuring gas flow prior to separation.

$Z_{p,i}$  = If a multiphase flow meter is used to measure flowback during the initial period, then  $Z_{p,i}$  is equal to 1. If flowback is measured using a recording flow meter (digital or analog) on the vent line to measure the flowback, at the beginning of the period of time when sufficient quantities of gas are present to enable separation, then  $Z_{p,i}$  is equal to 0.5.

- (1) If you elect to use equation W-10A to this section on gas wells, you must use Calculation Method 1 as specified in paragraph (g)(1)(i) of this section. If you are unable to measure the gas flowback rates using a recording flow meter for gas well completions or workovers as described in Calculation Method 1, for example due to field conditions, operating conditions, or health and safety considerations, you may use Calculation Method 2 as specified in paragraph (g)(1)(ii) of this section to determine the value of  $FRM_s$  and  $FRM_i$ . These values must be based on the flow rate for flowback gases, once sufficient gas is present to enable separation. The number of measurements or calculations required to estimate  $FRM_s$  and  $FRM_i$  must be determined individually for completions and workovers per sub-basin and well type combination as follows: Complete measurements or calculations for at least one completion or workover for less than or equal to 25 completions or workovers for each well type combination within a sub-basin; complete measurements or calculations for at least two completions or workovers for 26 to 50 completions or workovers for each sub-basin and well type combination; complete measurements or calculations for at least three completions or workovers for 51 to 100 completions or workovers for each sub-basin and well type combination; complete measurements or calculations for at least four completions or workovers for 101 to 250 completions or workovers for each sub-basin and well type combination; and complete measurements or calculations for at least five completions or workovers for greater than 250 completions or workovers for each sub-basin and well type combination.
- (i) **Calculation Method 1.** You must use equation W-12A to this section as specified in paragraph (g)(1)(iii) of this section to determine the value of  $FRM_s$ . You must use equation W-12B to this section as specified in paragraph (g)(1)(iv) of this section to determine the value of  $FRM_i$ . The procedures specified in paragraphs (g)(1)(v) and (vi) of this section also apply. When making gas flowback measurements for use in equations W-12A and W-12B to this section, you must use a recording flow meter (digital or analog) installed on the vent line, downstream of a separator and ahead of a flare or vent, to measure the gas flowback rates in units of standard cubic feet per hour according to methods set forth in § 98.234(b). Alternatively, you may use a multiphase flow meter placed on the flow line downstream of the wellhead and ahead of the separator to directly measure gas flowback during the initial period when flowback is routed to open pits or tanks. If you use a multiphase flow meter, measurements must be taken from initiation of flowback to the beginning of the period of time when sufficient quantities of gas are present to enable separation.
- (ii) **Calculation Method 2 (for gas wells).** You must use equation W-12A to this section as specified in paragraph (g)(1)(iii) of this section to determine the value of  $FRM_s$ . You must use equation W-12B to this section as specified in paragraph (g)(1)(iv) of this section to determine the value of  $FRM_i$ . The procedures specified in paragraphs (g)(1)(v) and (vi) also apply. When calculating the flowback rates for use in equations W-12A and W-12B to this section based on well parameters, you must record the well flowing pressure immediately upstream (and immediately downstream in subsonic flow) of a well choke according to methods set forth in § 98.234(b) to calculate the well flowback. The upstream pressure must be surface pressure and reservoir pressure cannot be assumed. The downstream pressure must be measured after the choke and atmospheric pressure cannot be assumed. Calculate flowback rate using equation W-11A to this section for subsonic flow or equation W-11B to this section for sonic flow. You must use best engineering estimates based on best available data along with equation W-11C to this section to determine whether the predominant flow is sonic or subsonic. If the value of  $R$  in equation W-11C to this section is greater than or equal to 2, then flow is sonic; otherwise, flow

is subsonic. Convert calculated  $FR_a$  values from actual conditions upstream of the restriction orifice to standard conditions ( $FR_{s,p}$  and  $FR_{i,p}$ ) for use in equations W-12A and W-12B to this section using equation W-33 to this section.

$$FR_a = 1.27 * 10^5 * A * \sqrt{3430 * T_u * \left[ \left( \frac{P_2}{P_1} \right)^{1.515} - \left( \frac{P_2}{P_1} \right)^{1.758} \right]} \quad (\text{Eq. W-11A})$$

Where:

$FR_a$  = Flowback rate in actual cubic feet per hour, under actual subsonic flow conditions.

A = Cross sectional open area of the restriction orifice ( $m^2$ ).

$P_1$  = Pressure immediately upstream of the choke (psia).

$T_u$  = Temperature immediately upstream of the choke (degrees Kelvin).

$P_2$  = Pressure immediately downstream of the choke (psia).

3430 = Constant with units of  $m^2/(\text{sec}^2 * K)$ .

$1.27 * 10^5$  = Conversion from  $m^3/\text{second}$  to  $\text{ft}^3/\text{hour}$ .

$$FR_a = 1.27 * 10^5 * A * \sqrt{187.08 * T_u} \quad (\text{Eq. W-11B})$$

Where:

$FR_a$  = Flowback rate in actual cubic feet per hour, under actual sonic flow conditions.

A = Cross sectional open area of the restriction orifice ( $m^2$ ).

$T_u$  = Temperature immediately upstream of the choke (degrees Kelvin).

187.08 = Constant with units of  $m^2/(\text{sec}^2 * K)$ .

$1.27 * 10^5$  = Conversion from  $m^3/\text{second}$  to  $\text{ft}^3/\text{hour}$ .

$$R = P_1 / P_2 \quad (\text{Eq. W-11C})$$

Where:

R = Pressure ratio.

$P_1$  = Pressure immediately upstream of the choke (psia).

$P_2$  = Pressure immediately downstream of the choke (psia).

(iii) For equation W-10A to this section, calculate FRMs using equation W-12A to this section.

$$FRM_s = \frac{\sum_{p=1}^N FR_{s,p}}{\sum_{p=1}^N PR_{s,p}} \quad (\text{Eq. W-12A})$$

Where:

$FRM_s$  = Ratio of average gas flowback rate, during the period of time when sufficient quantities of gas are present to enable separation, of well completions and workovers from hydraulic fracturing to 30-day gas production rate for each sub-basin and well type combination.

$FR_{s,p}$  = Measured average gas flowback rate from Calculation Method 1 described in paragraph (g)(1)(i) of this section or calculated average flowback rate from Calculation Method 2 described in paragraph (g)(1)(ii) of this section, during the separation period in standard cubic feet per hour for well(s) p for each sub-basin and well type combination. Convert measured and calculated  $FR_a$  values from actual conditions upstream of the restriction orifice ( $FR_a$ ) to standard conditions ( $FR_{s,p}$ ) for each well p using equation W-33 to this section. You may not use flow volume as used in equation W-10B to this section converted to a flow rate for this parameter.

$PR_{s,p}$  = Average gas production flow rate during the first 30 days of production after completions of newly drilled wells or well workovers using hydraulic fracturing, in standard cubic feet per hour for each well, p, that was measured in the sub-basin and well type combination. For oil wells for which production is not measured continuously during the first 30 days of production, the average flow rate may be based on individual well production tests conducted within the first 30 days of production. Alternatively, if applicable,  $PR_{s,p}$  may be calculated for oil wells using procedures specified in paragraph (g)(1)(vii) of this section.

N = Number of measured or calculated well completions or workovers using hydraulic fracturing in a sub-basin and well type combination.

(iv) For equation W-10A to this section, calculate FRMi using equation W-12B to this section.

$$FRM_i = \frac{\sum_{p=1}^N FR_{i,p}}{\sum_{p=1}^N PR_{s,p}} \quad (\text{Eq. W-12B})$$

Where:

$FRM_i$  = Ratio of initial gas flowback rate during well completions and workovers from hydraulic fracturing to 30-day gas production rate for the sub-basin and well type combination, for the period of flow to open tanks/pits.

$FR_{i,p}$  = Initial measured gas flowback rate from Calculation Method 1 described in paragraph (g)(1)(i) of this section or initial calculated flow rate from Calculation Method 2 described in paragraph (g)(1)(ii) of this section in standard cubic feet per hour for well(s), p, for each sub-basin and well type combination. Measured and calculated  $FR_{i,p}$  values must be based on flow conditions at the beginning of the separation period and must be expressed at standard conditions or measured using a multiphase flow meter installed upstream of the separator capable of accurately measuring gas flow prior to separation.

$PR_{s,p}$  = Average gas production flow rate during the first 30-days of production after completions of newly drilled wells or well workovers using hydraulic fracturing, in standard cubic feet per hour of each well, p, that was measured in the sub-basin and well type combination. For oil wells for which production is not measured continuously during the first 30 days of production, the average flow rate may be based on individual well production tests conducted within the first 30 days of production. Alternatively, if applicable,  $PR_{s,p}$  may be calculated for oil wells using procedures specified in paragraph (g)(1)(vii) of this section.

N = Number of measured or calculated well completions or workovers using hydraulic fracturing in a sub-basin and well type combination.

- (v) For equation W-10A to this section, the ratio of gas flowback rate during well completions and workovers from hydraulic fracturing to 30-day gas production rate are applied to all well completions and well workovers, respectively, in the sub-basin and well type combination for the total number of hours of flowback and for the first 30 day average gas production rate for each of these wells.
- (vi) For equations W-12A and W-12B to this section, calculate new flowback rates for well completions and well workovers in each sub-basin and well type combination once every two years starting in the first calendar year of data collection.
- (vii) For oil wells where the gas production rate is not metered and you elect to use equation W-10A to this section, calculate the average gas production rate ( $PR_{s,p}$ ) using equation W-12C to this section. If GOR cannot be determined from your available data, then you must use one of the procedures specified in paragraph (g)(1)(vii)(A) or (B) of this section to determine GOR. If GOR from each well is not available, use the GOR from a cluster of wells in the same sub-basin category.

$$PR_{s,p} = GOR_p * \frac{V_p}{720} \quad (\text{Eq. W-12C})$$

Where:

$PR_{s,p}$  = Average gas production flow rate during the first 30 days of production after completions of newly drilled wells or well workovers using hydraulic fracturing in standard cubic feet per hour of well p, in the sub-basin and well type combination.

$GOR_p$  = Average gas to oil ratio during the first 30 days of production after completions of newly drilled wells or workovers using hydraulic fracturing in standard cubic feet of gas per barrel of oil for each well  $p$ , that was measured in the sub-basin and well type combination; oil here refers to hydrocarbon liquids produced of all API gravities.

$V_p$  = Volume of oil produced during the first 30 days of production after completions of newly drilled wells or well workovers using hydraulic fracturing in barrels of each well  $p$ , that was measured in the sub-basin and well type combination.

720 = Conversion from 30 days of production to hourly production rate.

(A) You may use an appropriate standard method published by a consensus-based standards organization if such a method exists.

(B) You may use an industry standard practice as described in § 98.234(b).

(2) For paragraphs (g) introductory text and (g)(1) of this section, measurements and calculations are completed separately for workovers and completions per sub-basin and well type combination. A well type combination is a unique combination of the parameters listed in paragraphs (g)(2)(i) through (iv) of this section.

(i) Vertical or horizontal (directional drilling).

(ii) With flaring or without flaring.

(iii) Reduced emission completion/workover or not reduced emission completion/workover.

(iv) Oil well or gas well.

(3) Calculate both  $CH_4$  and  $CO_2$  volumetric and mass emissions from total natural gas volumetric emissions using calculations in paragraphs (u) and (v) of this section.

(h) **Gas well venting during completions and workovers without hydraulic fracturing.** Calculate annual volumetric natural gas emissions from each gas well venting during workovers without hydraulic fracturing using equation W-13A to this section. Calculate annual volumetric natural gas emissions from each gas well venting during completions without hydraulic fracturing using equation W-13B to this section. You must convert annual volumetric natural gas emissions to  $CH_4$  and  $CO_2$  volumetric and mass emissions as specified in paragraph (h)(1) of this section. If emissions from gas well venting during completions and workovers without hydraulic fracturing are routed to a flare, you must calculate  $CH_4$ ,  $CO_2$ , and  $N_2O$  annual emissions as specified in paragraph (n) of this section, report emissions from the flare as specified in § 98.236(n), and report additional information specified in § 98.236(h), as applicable.

$$E_{s,wo} = N_{wo} * EF_{wo} \quad (\text{Eq. W-13A})$$

$$E_{s,p} = V_p \times T_p \quad (\text{Eq. W-13B})$$

Where:

$E_{s,wo}$  = Annual volumetric natural gas emissions in standard cubic feet from gas well venting during well workovers without hydraulic fracturing.

$N_{wo}$  = Number of workovers per well that do not involve hydraulic fracturing in the reporting year.



$EF_{wo}$  = Emission factor for non-hydraulic fracture well workover venting in standard cubic feet per workover. Use 3,114 standard cubic feet natural gas per well workover without hydraulic fracturing.

$E_{s,p}$  = Annual volumetric natural gas emissions in standard cubic feet from gas well venting during well completions without hydraulic fracturing.

$V_p$  = Average daily gas production rate in standard cubic feet per hour for each well, p, undergoing completion without hydraulic fracturing. This is the total annual gas production volume divided by total number of hours the well produced to the flow-line. For completed wells that have not established a production rate, you may use the average flow rate from the first 30 days of production. In the event that the well is completed less than 30 days from the end of the calendar year, the first 30 days of the production straddling the current and following calendar years shall be used.

$T_p$  = Time that gas is vented directly to the atmosphere for each well, p, undergoing completion without hydraulic fracturing, in hours during the year.

- (1) Calculate both  $CH_4$  and  $CO_2$  volumetric emissions from natural gas volumetric emissions using calculations in paragraph (u) of this section. Calculate both  $CH_4$  and  $CO_2$  mass emissions from volumetric emissions vented to atmosphere using calculations in paragraph (v) of this section.

- (2) [Reserved]

- (i) **Blowdown vent stacks.** Calculate  $CO_2$  and  $CH_4$  blowdown vent stack emissions from the depressurization of equipment to reduce system pressure for planned or emergency shutdowns resulting from human intervention or to take equipment out of service for maintenance as specified in either paragraph (i)(2) or (3) of this section. You may use the method in paragraph (i)(2) of this section for some blowdown vent stacks at your facility and the method in paragraph (i)(3) of this section for other blowdown vent stacks at your facility. For industry segments other than natural gas distribution, equipment with a unique physical volume of less than 50 cubic feet as determined in paragraph (i)(1) of this section are not subject to the requirements in paragraphs (i)(2) through (4) of this section. Natural gas distribution blowdowns with a unique physical volume of less than 500 cubic feet as determined in paragraph (i)(1) of this section are not subject to the requirements in paragraphs (i)(2) through (4) of this section. The requirements in this paragraph (i) do not apply to blowdown vent stack emissions from depressurizing to a flare, over-pressure relief, operating pressure control venting, blowdown of non-GHG gases, and desiccant dehydrator blowdown venting before reloading. If emissions from blowdown vent stacks are routed to a flare, you must calculate  $CH_4$ ,  $CO_2$ , and  $N_2O$  annual emissions as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).

- (1) **Method for calculating unique physical volumes or distribution pipeline physical volumes.** You must calculate each unique physical volume (including pipelines, compressor case or cylinders, manifolds, suction bottles, discharge bottles, and vessels) between isolation valves, in cubic feet, by using engineering estimates based on best available data. For natural gas distribution pipelines without isolation valves, calculate the unique physical volume of the distribution pipeline section that was isolated from operation by methods other than isolation valves, in cubic feet, by using engineering estimates based on best available data (e.g., diameter of the pipeline and length of isolated section).
- (2) **Method for determining emissions from blowdown vent stacks according to equipment or event type.** If you elect to determine emissions according to each equipment or event type, using unique physical volumes as calculated in paragraph (i)(1) of this section, you must calculate emissions as



specified in paragraph (i)(2)(i) of this section and either paragraph (i)(2)(ii) of this section or, if applicable, paragraph (i)(2)(iii) of this section for each equipment or event type. Categorize equipment and event types for each industry segment as specified in paragraph (i)(2)(iv) of this section.

- (i) Calculate the total annual natural gas emissions from each unique physical volume that is blown down using either equation W-14A or W-14B to this section.

$$E_{s,n} = N * \left( V \left( \frac{(459.67 + T_s) P_a}{(459.67 + T_a) P_s Z_a} \right) - V * C \right) \quad (\text{Eq. W-14A})$$

Where:

$E_{s,n}$  = Annual natural gas emissions at standard conditions from each unique physical volume that is blown down, in cubic feet.

N = Number of occurrences of blowdowns for each unique physical volume in the calendar year.

V = Unique physical volume, in cubic feet, as calculated in paragraph (i)(1) of this section.

C = Purge factor is 1 if the unique physical volume is not purged, or 0 if the unique physical volume is purged using non-GHG gases.

$T_s$  = Temperature at standard conditions (60 °F).

$T_a$  = Temperature at actual conditions in the unique physical volume (°F). For emergency blowdowns at onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting facilities, onshore natural gas transmission pipeline facilities, and natural gas distribution facilities, engineering estimates based on best available information may be used to determine the temperature.

$P_s$  = Absolute pressure at standard conditions (14.7 psia).  $P_a$  = Absolute pressure at actual conditions in the unique physical volume (psia). For emergency blowdowns at onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting facilities, onshore natural gas transmission pipeline facilities, and natural gas distribution facilities, engineering estimates based on best available information may be used to determine the pressure.

$Z_a$  = Compressibility factor at actual conditions for natural gas. You may use either a default compressibility factor of 1, or a site-specific compressibility factor based on actual temperature and pressure conditions.

$$E_{s,n} = \sum_{p=1}^N \left[ V_p \left( \frac{(459.67 + T_s) (P_{a,b,p} - P_{a,e,p})}{(459.67 + T_{a,p}) P_s Z_a} \right) \right] \quad (\text{Eq. W-14B})$$

Where:

$E_{s,n}$  = Annual natural gas emissions at standard conditions from each unique physical volume that is blown down, in cubic feet.

$p$  = Individual occurrence of blowdown for the same unique physical volume.

$N$  = Number of occurrences of blowdowns for each unique physical volume in the calendar year.

$V_p$  = Unique physical volume, in cubic feet, for each blowdown “p.”

$T_s$  = Temperature at standard conditions (60 °F).  $T_{a,p}$  = Temperature at actual conditions in the unique physical volume (°F) for each blowdown “p”. For emergency blowdowns at onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting facilities, onshore natural gas transmission pipeline facilities, and natural gas distribution facilities, engineering estimates based on best available information may be used to determine the temperature.

$P_s$  = Absolute pressure at standard conditions (14.7 psia).

$P_{a,b,p}$  = Absolute pressure at actual conditions in the unique physical volume (psia) at the beginning of the blowdown “p”. For emergency blowdowns at onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting facilities, onshore natural gas transmission pipeline facilities, and natural gas distribution facilities, engineering estimates based on best available information may be used to determine the pressure at the beginning of the blowdown.

$P_{a,e,p}$  = Absolute pressure at actual conditions in the unique physical volume (psia) at the end of the blowdown “p”; 0 if blowdown volume is purged using non-GHG gases. For emergency blowdowns at onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting facilities, onshore natural gas transmission pipeline facilities, and natural gas distribution facilities, engineering estimates based on best available information may be used to determine the pressure at the end of the blowdown.

$Z_a$  = Compressibility factor at actual conditions for natural gas. You may use either a default compressibility factor of 1, or a site-specific compressibility factor based on actual temperature and pressure conditions.

- (ii) Except as allowed in paragraph (i)(2)(iii) of this section, calculate annual CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions from each unique physical volume that is blown down by using the annual natural gas emission value as calculated in either equation W-14A or equation W-14B to this section and the calculation method specified in paragraph (i)(4) of this section. Calculate the total annual CH<sub>4</sub> and CO<sub>2</sub> emissions for each equipment or event type by summing the annual CH<sub>4</sub> and CO<sub>2</sub> mass emissions for all unique physical volumes associated with the equipment or event type.
- (iii) For onshore natural gas transmission compression facilities and LNG import and export equipment, as an alternative to using the procedures in paragraph (i)(2)(ii) of this section, you may elect to sum the annual natural gas emissions as calculated using either equation W-14A or equation W-14B to this section for all unique physical volumes associated with the equipment type or event type. Calculate the total annual CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions for each equipment type or event type using the sums of the total annual natural gas emissions for each equipment type and the calculation method specified in paragraph (i)(4) of this section.

(iv) Categorize blowdown vent stack emission events as specified in paragraphs (i)(2)(iv)(A) and (B) of this section, as applicable.

(A) For the onshore petroleum and natural gas production, onshore natural gas processing, onshore natural gas transmission compression, underground natural gas storage, LNG storage, LNG import and export equipment, and onshore petroleum and natural gas gathering and boosting industry segments, equipment or event types must be grouped into the following seven categories: Facility piping (*i.e.*, physical volumes associated with piping for which the entire physical volume is located within the facility boundary), pipeline venting (*i.e.*, physical volumes associated with pipelines for which a portion of the physical volume is located outside the facility boundary and the remainder, including the blowdown vent stack, is located within the facility boundary), compressors, scrubbers/strainers, pig launchers and receivers, emergency shutdowns (this category includes emergency shutdown blowdown emissions regardless of equipment type), and all other equipment with a physical volume greater than or equal to 50 cubic feet. If a blowdown event resulted in emissions from multiple equipment types and the emissions cannot be apportioned to the different equipment types, then categorize the blowdown event as the equipment type that represented the largest portion of the emissions for the blowdown event.

(B) For the onshore natural gas transmission pipeline and natural gas distribution industry segments, pipeline segments or event types must be grouped into the following eight categories: Pipeline integrity work (*e.g.*, the preparation work of modifying facilities, ongoing assessments, maintenance or mitigation), traditional operations or pipeline maintenance, equipment replacement or repair (*e.g.*, valves), pipe abandonment, new construction or modification of pipelines including commissioning and change of service, operational precaution during activities (*e.g.* excavation near pipelines), emergency shutdowns including pipeline incidents as defined in 49 CFR 191.3, and all other pipeline segments with a physical volume greater than or equal to 50 cubic feet. If a blowdown event resulted in emissions from multiple categories and the emissions cannot be apportioned to the different categories, then categorize the blowdown event in the category that represented the largest portion of the emissions for the blowdown event.

(3) **Method for determining emissions from blowdown vent stacks using a flow meter.** In lieu of determining emissions from blowdown vent stacks as specified in paragraph (i)(2) of this section, you may use a flow meter and measure blowdown vent stack emissions for any unique physical volumes determined according to paragraph (i)(1) of this section to be greater than or equal to 50 cubic feet. If you choose to use this method, you must measure the natural gas emissions from the blowdown(s) through the monitored stack(s) using a flow meter according to methods in § 98.234(b) and calculate annual CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions measured by the meters according to paragraph (i)(4) of this section.

(4) **Method for converting from natural gas emissions to GHG volumetric and mass emissions.** Calculate both CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions using the methods specified in paragraphs (u) and (v) of this section.

(j) **Hydrocarbon liquids and produced water storage tanks.** Calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from atmospheric pressure storage tanks receiving hydrocarbon liquids and CH<sub>4</sub> emissions from atmospheric pressure storage tanks receiving produced water, from onshore petroleum and natural gas production facilities, onshore petroleum and natural gas gathering and boosting facilities (including stationary liquid

storage not owned or operated by the reporter), and onshore natural gas processing facilities as specified in this paragraph (j). For wells, gas-liquid separators, or onshore petroleum and natural gas gathering and boosting or onshore natural gas processing non-separator equipment (e.g., stabilizers, slug catchers) with annual average daily throughput of hydrocarbon liquids greater than or equal to 10 barrels per day, calculate annual CH<sub>4</sub> and CO<sub>2</sub> using Calculation Method 1 or 2 as specified in paragraphs (j)(1) and (2) of this section. For wells, gas-liquid separators, or non-separator equipment with annual average daily throughput of hydrocarbon liquids greater than 0 barrels per day and less than 10 barrels per day, calculate annual CH<sub>4</sub> and CO<sub>2</sub> emissions using Calculation Method 1, 2, or 3 as specified in paragraphs (j)(1) through (3) of this section. Annual average daily throughput of hydrocarbon liquids should be calculated using the flow out of the separator, well, or non-separator equipment determined over the actual days of operation. For atmospheric pressure storage tanks receiving produced water, calculate annual CH<sub>4</sub> emissions using Calculation Method 1, 2, or 3 as specified in paragraphs (j)(1) through (3) of this section. If you are required to use the flash emissions modeling software in paragraph (j)(1) of this section for compliance with federal or state regulations, air permit requirements, or annual inventory reporting for the current reporting year, you must use Calculation Method 1 to calculate annual CH<sub>4</sub> and, if applicable, CO<sub>2</sub> emissions. For atmospheric pressure storage tanks routing emissions to a vapor recovery system or a flare, calculate annual emissions vented directly to atmosphere as specified in paragraph (j)(4) of this section. If you use Calculation Method 1 or Calculation Method 2 for gas-liquid separators sending hydrocarbon liquids to atmospheric pressure storage tanks, you must also calculate emissions that may have occurred due to hydrocarbon liquid dump valves not closing properly using the method specified in paragraph (j)(5) of this section. If emissions from atmospheric pressure storage tanks are routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions for the flare stack as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).

- (1) **Calculation Method 1.** For atmospheric pressure storage tanks receiving hydrocarbon liquids, calculate annual CH<sub>4</sub> and CO<sub>2</sub> emissions, and for atmospheric pressure tanks receiving produced water, calculate annual CH<sub>4</sub> emissions, using operating conditions in the well, last gas-liquid separator, or last non-separator equipment before liquid transfer to storage tanks. Calculate flashing emissions with a software program, such as AspenTech HYSYS®, Bryan Research & Engineering ProMax®, or, for atmospheric pressure storage tanks receiving hydrocarbon liquids from gas-liquid separator or non-separator equipment, API 4697 E&P Tank, that uses the Peng-Robinson equation of state, models flashing emissions, and speciates CH<sub>4</sub> and CO<sub>2</sub> emissions that will result when the hydrocarbon liquids or produced water from the well, separator, or non-separator equipment enter an atmospheric pressure storage tank. If you elect to use ProMax®, you must use version 5.0 or above. A minimum of the parameters listed in paragraphs (j)(1)(i) through (vii) of this section, as applicable, must be used to characterize emissions. If paragraphs (j)(1)(i) through (vii) of this section indicate that an applicable parameter must be measured, collect measurements reflective of representative operating conditions for the time period covered by the simulation and at least at the frequency specified. Determine all other applicable parameters in paragraphs (j)(1)(i) through (vii) of this section by engineering estimate and process knowledge based on best available data and, if necessary, adjust parameters to represent the operating conditions over the time period covered by the simulation. Determine the number of simulations and associated time periods such that the simulations cover the entire reporting year (i.e., if you calculate emissions using one simulation, use representative parameters for the operating conditions over the calendar year; if you use periodic simulations to cover the calendar year, use parameters for the operating conditions over each corresponding appropriate portion of the calendar year). If more than one simulation is performed, input parameters should be remeasured if no longer representative of operating conditions.

- (i) Well, separator, or non-separator equipment temperature (must be measured at least annually if required as an input for the model).
- (ii) Well, separator, or non-separator equipment pressure (must be measured at least annually if required as an input for the model).
- (iii) [Reserved]
- (iv) Sales or stabilized hydrocarbon liquids or produced water production rate (must be measured at least annually if required as an input for the model).
- (v) Ambient air temperature.
- (vi) Ambient air pressure.
- (vii) Sales or stabilized hydrocarbon liquids API gravity, and well, separator, or non-separator equipment hydrocarbon liquids or produced water composition and Reid vapor pressure (must be measured if required as an input for the model). Use an appropriate standard method published by a consensus-based standards organization if such a method exists or you may use an industry standard practice as specified in § 98.234(b) to sample and analyze sales or stabilized hydrocarbon liquids for API gravity, and hydrocarbon liquids or produced water composition and Reid vapor pressure. You must sample and analyze sales or stabilized oil for API gravity, and hydrocarbon liquids or produced water for composition and Reid vapor pressure within six months of equipment start-up or by January 1, 2030, whichever is later, and at least once every five years thereafter. Until such time that a sample is collected, determine API gravity by engineering estimate and process knowledge based on best available data, and determine composition and Reid vapor pressure by using one of the methods described in paragraphs (j)(1)(vii)(A) through (C) of this section. For produced water, you may instead elect to use a representative sales oil or stabilized hydrocarbon liquid API gravity and a hydrocarbon liquid composition and Reid vapor pressure, and assume oil entrainment of 1 percent or greater.
  - (A) If separator or non-separator equipment hydrocarbon liquids composition and Reid vapor pressure default data are provided with the software program, select the default values that most closely match your separator or non-separator equipment pressure first, and API gravity secondarily.
  - (B) If separator or non-separator equipment hydrocarbon liquids composition and Reid vapor pressure data are available through your previous analysis, select the latest available analysis that is representative of hydrocarbon liquids from the sub-basin category for onshore petroleum and natural gas production or from the county for onshore petroleum and natural gas gathering and boosting.
  - (C) Analyze a representative sample of separator or non-separator equipment hydrocarbon liquids in each sub-basin category for onshore petroleum and natural gas production or each county for onshore petroleum and natural gas gathering and boosting for hydrocarbon liquids composition and Reid vapor pressure using an appropriate standard method published by a consensus-based standards organization.

- (2) **Calculation Method 2.** For atmospheric pressure storage tanks receiving hydrocarbon liquids, calculate annual CH<sub>4</sub> and CO<sub>2</sub> emissions and for atmospheric pressure tanks receiving produced water, calculate annual CH<sub>4</sub> emissions, using operating conditions in the well, last gas-liquid separator, or last non-separator equipment before liquid transfer to storage tanks and the methods in paragraph (j)(2)(i) of this section.
- (i) Assume that all of the CH<sub>4</sub> and, if applicable, CO<sub>2</sub> in solution at well, separator, or non-separator equipment temperature and pressure is emitted from hydrocarbon liquids or produced water sent to atmospheric pressure storage tanks. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or you may use an industry standard practice as described in § 98.234(b) to sample and analyze hydrocarbon liquids or produced water composition at well, separator, or non-separator pressure and temperature. You must sample and analyze hydrocarbon liquids or produced water composition within six months of equipment start-up or by January 1, 2030, whichever is later, and at least once every five years thereafter. Until such time that a sample is collected, determine produced water composition by engineering estimate and process knowledge based on best available data, and determine hydrocarbon liquids composition by using one of the methods described in paragraphs (j)(1)(vii)(A) through (C) of this section. For produced water, you may instead elect to use a representative hydrocarbon liquid composition and assume oil entrainment of 1 percent or greater.
- (ii) [Reserved]
- (3) **Calculation Method 3.** Calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from atmospheric pressure storage tanks receiving hydrocarbon liquids as specified in paragraph (j)(3)(i) of this section. Calculate CH<sub>4</sub> emissions from atmospheric pressure storage tanks receiving produced water as specified in paragraph (j)(3)(ii) of this section.
- (i) Calculate CH<sub>4</sub> and CO<sub>2</sub> emissions from atmospheric pressure storage tanks receiving hydrocarbon liquids using equation W-15A to this section:

$$E_{s,i} = EF_i \times Count \times 1,000 \quad (Eq. W-15A)$$

Where:

$E_{s,i}$  = Annual total volumetric GHG emissions (either CO<sub>2</sub> or CH<sub>4</sub>) at standard conditions in cubic feet.

$EF_i$  = Population emission factor for separators, wells, or non-separator equipment in thousand standard cubic feet per separator, well, or non-separator equipment per year, for crude oil use 4.2 for CH<sub>4</sub> and 2.8 for CO<sub>2</sub> at 60 °F and 14.7 psia, and for gas condensate use 17.6 for CH<sub>4</sub> and 2.8 for CO<sub>2</sub> at 60 °F and 14.7 psia.

Count = Total number of separators, wells, or non-separator equipment with annual average daily throughput greater than 0 barrels per day and less than 10 barrels per day. Count only separators, wells, or non-separator equipment that feed hydrocarbon liquids directly to the atmospheric pressure storage tank for which you elect to use this Calculation Method 3.

1,000 = Conversion from thousand standard cubic feet to standard cubic feet.

- (ii) Calculate CH<sub>4</sub> emissions from atmospheric pressure storage tanks receiving produced water using equation W-15B to this section:

$$Mass_{CH_4} = EF_{CH_4} \times FR \times 0.001 \quad (\text{Eq. W-15B})$$

Where:

$Mass_{CH_4}$  = Annual total  $CH_4$  emissions in metric tons.

$EF_{CH_4}$  = Population emission factor for produced water in metric tons  $CH_4$  per thousand barrels produced water per year. For produced water streams from separators, wells, or non-separator equipment with pressure less than or equal to 50 psi, use 0.0015. For produced water streams from separators, wells, or non-separator equipment with pressure greater than 50 but less than or equal to 250 psi, use 0.0142. For produced water streams from separators, wells, or non-separator equipment with pressure greater than 250 psi, use 0.0508. Pressure should be representative of separators, wells, or non-separator equipment that feed produced water directly to the atmospheric pressure storage tank.

FR = Annual flow rate of produced water to atmospheric pressure storage tanks, in barrels.

0.001 = Conversion from barrels to thousand barrels.

- (4) **Emissions vented directly to atmosphere from atmospheric pressure storage tanks routed to vapor recovery systems or flares.** If the atmospheric pressure storage tank receiving your hydrocarbon liquids or produced water has a vapor recovery system or routes emissions to a flare, calculate annual emissions vented directly to atmosphere from the storage tank during periods of time when emissions were not routed to the vapor recovery system or flare as specified in paragraph (j)(4)(i) of this section. Determine recovered mass as specified in paragraph (j)(4)(ii) of this section.
- (i) For an atmospheric pressure storage tank that routes any emissions to a vapor recovery system or a flare, calculate vented emissions as specified in paragraphs (j)(4)(i)(A) through (E) of this section.
- (A) Calculate vented emissions as specified in paragraph (j)(1), (2), or (3) of this section, which represents the emissions from the atmospheric storage tank prior to the vapor recovery system or flare. Calculate an average hourly vented emissions rate by dividing the vented emissions by the number of hours that the tank was in operation.
- (B) To calculate vented emissions during periods when the tank was not routing emissions to a vapor recovery system or a flare, multiply the average hourly vented emissions rate determined in paragraph (j)(4)(i)(A) of this section by the number of hours that the tank vented directly to the atmosphere. Determine the number of hours that the tank vented directly to atmosphere by subtracting the hours that the tank was connected to a vapor recovery system or flare (based on engineering estimate and best available data) from the total operating hours for the tank in the calendar year. If emissions are routed to a flare but the flare is unlit, calculate emissions in accordance with the methodology specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
- (C) During periods when a thief hatch is open and emissions from the tank are routed to a vapor recovery system or a flare, assume the capture efficiency of the vapor recovery system or a flare is 0 percent. A thief hatch is open if it is fully or partially open such there is a visible gap between the hatch cover and the hatch portal. To calculate vented emissions during such periods, multiply the average hourly vented emissions rate



determined in paragraph (j)(4)(i)(A) of this section by the number of hours that the thief hatch is open. Determine the number of hours that the thief hatch is open as specified in paragraph (j)(7) of this section.

- (D) Calculate vented emissions not captured by the vapor recovery system or a flare due to causes other than open thief hatches based on best available data, including any data from operating pressure sensors on atmospheric pressure storage tanks.
- (E) Calculate total emissions vented directly to atmosphere as the sum of the emissions calculated as specified in paragraphs (j)(4)(i)(B) through (D) of this section.
- (ii) Using engineering estimates based on best available data, determine the portion of the total emissions estimated in paragraphs (j)(1) through (3) of this section that is recovered using a vapor recovery system. You must take into account periods with reduced capture efficiency of the vapor recovery system (e.g., when a thief hatch is open) when calculating mass recovered as specified in paragraphs (j)(4)(i)(C) and (D) of this section.
- (5) **Gas-liquid separator dump valves.** If you use Calculation Method 1 or Calculation Method 2 in paragraph (j)(1) or (2) of this section, calculate emissions from occurrences of gas-liquid separator liquid dump valves that did not close properly during the calendar year by using equation W-16 to this section. Determine the total time a dump valve did not close properly in the calendar year ( $T_{dv}$ ) as specified in paragraph (j)(5)(i) of this section.

$$E_{s,i,dv} = CF_{dv} \times \frac{E_{s,i}}{8,760} \times T_{dv} \quad (\text{Eq. W-16})$$

Where:

$E_{s,i,dv}$  = Annual volumetric GHG emissions (either CO<sub>2</sub> or CH<sub>4</sub>) at standard conditions in cubic feet from atmospheric pressure storage tanks that resulted from the dump valve on an associated gas-liquid separator that did not close properly.

$CF_{dv}$  = Correction factor for tank emissions for time period  $T_{dv}$  is 2.87 for crude oil production. Correction factor for tank emissions for time period  $T_{dv}$  is 4.37 for gas condensate production.

$E_{s,i}$  = Annual volumetric GHG emissions (either CO<sub>2</sub> or CH<sub>4</sub>) as determined in paragraphs (j)(1) and (2) and, if applicable, (j)(4) of this section, in standard cubic feet per year, from atmospheric pressure storage tanks with dump valves on an associated gas-liquid separator that did not close properly.

8,760 = Conversion to hourly emissions.

$T_{dv}$  = Total time a dump valve did not close properly in the calendar year as determined in paragraph (j)(5)(i) of this section, in hours.

- (i) If a parametric monitor is operating on a controlled atmospheric pressure storage tank or gas-liquid separator, you must use data obtained from the parametric monitor to determine periods when the gas-liquid separator liquid dump valve is stuck in an open or partially open position. An applicable operating parametric monitor must be capable of logging data whenever a gas-liquid separator liquid dump valve is stuck in an open or partially open position, as well as when the gas-liquid separator liquid dump valve is subsequently closed. If an applicable parametric



monitor is not operating, including during periods of time when the parametric monitor is malfunctioning, you must perform an audio, visual, and olfactory inspection of each gas-liquid separator liquid dump valve to determine if the valve is stuck in an open or partially open position, in accordance with paragraphs (j)(5)(i)(A) and (B) of this section.

(A) Audio, visual and olfactory inspections must be conducted at least once in a calendar year.

(B) If stuck gas-liquid separator liquid dump valve is identified, the dump valve must be counted as being open since the beginning of the calendar year, or from the previous audio, visual, and olfactory inspection that did not identify the dump valve as being stuck in the open position in the same calendar year. If the dump valve is fixed following audio, visual, and olfactory inspection, the time period for which the dump valve was stuck open will end upon being repaired. If a stuck dump valve is identified and not repaired, the time period for which the dump valve was stuck open must be counted as having occurred through the rest of the calendar year.

(ii) [Reserved]

(6) **Mass emissions.** Calculate both CH<sub>4</sub> and CO<sub>2</sub> mass emissions from natural gas volumetric emissions using calculations in paragraph (v) of this section.

(7) **Thief hatches.** If a thief hatch sensor is operating on a controlled atmospheric pressure storage tank, you must use data obtained from the thief hatch sensor to determine periods when the thief hatch is open. An applicable operating thief hatch sensor must be capable of logging data whenever a thief hatch is open, as well as when the thief hatch is subsequently closed. If a thief hatch sensor is not operating but a tank pressure sensor is operating on a controlled atmospheric pressure storage tank, you must use data obtained from the pressure sensor to determine periods when the thief hatch is open. An applicable operating pressure sensor must be capable of logging tank pressure data. If neither an applicable thief hatch sensor nor an applicable pressure sensor is operating, including during periods of time when the sensors are malfunctioning, for longer than 30 days, you must perform a visual inspection of each thief hatch on a controlled atmospheric pressure storage tank in accordance with paragraph (j)(7)(i) through (iii) of this section.

(i) For thief hatches on controlled atmospheric pressure storage tanks subject to the standards in § 60.5395b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, visual inspections must be conducted at least as frequent as the required audio, visual, and olfactory inspections described in § 60.5416b or the applicable approved state plan or applicable Federal plan in part 62. If the time between required audio, visual, and olfactory inspections described in § 60.5416b or the applicable approved state plan or applicable Federal plan in part 62 is greater than one year, visual inspections must be conducted at least annually.

(ii) For thief hatches on controlled atmospheric pressure storage tanks not subject to the standards in § 60.5395b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, visual inspections must be conducted at least once in a calendar year.

(iii) If one visual inspection is conducted in the calendar year and an open thief hatch is found, assume the thief hatch was open for the entire calendar year or the entire period that the sensor(s) was not operating or malfunctioning. If multiple visual inspections are conducted in the calendar year, assume a thief hatch found open in the first visual inspection was open since the beginning of the year until the date of the visual inspection; assume a thief hatch found

open in the last visual inspection of the year was open from the preceding visual inspection through the end of the year; assume a thief hatch found open in a visual inspection between the first and last visual inspections of the year was open since the preceding visual inspection until the date of the visual inspection.

- (k) **Condensate storage tanks.** For vent stacks connected to one or more condensate storage tanks, either water or hydrocarbon, without vapor recovery, flares, or other controls, in onshore natural gas transmission compression or underground natural gas storage, calculate CH<sub>4</sub> and CO<sub>2</sub> annual emissions from compressor scrubber dump valve leakage as specified in paragraphs (k)(1) through (4) of this section. If emissions from compressor scrubber dump valve leakage are routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O annual emissions as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n).
- (1) Except as specified in paragraph (k)(1)(iv) of this section, you must monitor the tank vapor vent stack annually for emissions using one of the methods specified in paragraphs (k)(1)(i) through (iii) of this section.
- (i) Use an optical gas imaging instrument according to methods set forth in § 98.234(a)(1).
  - (ii) Measure the tank vent directly using a flow meter or high volume sampler according to methods in § 98.234(b) or (d) for a duration of 5 minutes.
  - (iii) Measure the tank vent using a calibrated bag according to methods in § 98.234(c) for a duration of 5 minutes or until the bag is full, whichever is shorter.
  - (iv) You may annually monitor leakage through compressor scrubber dump valve(s) into the tank using an acoustic leak detection device according to methods set forth in § 98.234(a)(5).
- (2) If the tank vapors from the vent stack are continuous for 5 minutes, or the optical gas imaging instrument or acoustic leak detection device detects a leak, then you must use one of the methods in either paragraph (k)(2)(i) or (ii) of this section.
- (i) Use a flow meter, such as a turbine meter, calibrated bag, or high volume sampler to estimate tank vapor volumes from the vent stack according to methods set forth in § 98.234(b) through (d). If you do not have a continuous flow measurement device, you may install a flow measuring device on the tank vapor vent stack. If the vent is directly measured for five minutes under paragraph (k)(1)(ii) or (iii) of this section to detect continuous leakage, this serves as the measurement.
  - (ii) Use an acoustic leak detection device on each scrubber dump valve connected to the tank according to the method set forth in § 98.234(a)(5).
- (3) If a leaking dump valve is identified, the leak must be counted as having occurred since the beginning of the calendar year, or from the previous test that did not detect leaking in the same calendar year. If the leaking dump valve is fixed following leak detection, the leak duration will end upon being repaired. If a leaking dump valve is identified and not repaired, the leak must be counted as having occurred through the rest of the calendar year.
- (4) Use the requirements specified in paragraphs (k)(4)(i) and (ii) of this section to quantify annual emissions.
- (i) Use the appropriate gas composition in paragraph (u)(2)(iii) of this section.

- (ii) Calculate CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions at standard conditions using calculations in paragraphs (t), (u), and (v) of this section, as applicable to the monitoring equipment used.

(l) **Well testing venting and flaring.** Calculate CH<sub>4</sub> and CO<sub>2</sub> annual emissions from well testing venting as specified in paragraphs (l)(1) through (5) of this section. If emissions from well testing venting are routed to a flare, you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O annual emissions as specified in paragraph (n) of this section, report emissions from the flare as specified in § 98.236(n), and report additional information specified in § 98.236(l), as applicable.

- (1) Determine the gas to oil ratio (GOR) of the hydrocarbon production from oil well(s) tested. Determine the production rate from gas well(s) tested.
- (2) If GOR cannot be determined from your available data, then you must measure quantities reported in this section according to one of the procedures specified in paragraph (l)(2)(i) or (ii) of this section to determine GOR.
  - (i) You may use an appropriate standard method published by a consensus-based standards organization if such a method exists.
  - (ii) You may use an industry standard practice as described in § 98.234(b).
- (3) Estimate venting emissions using equation W-17A to this section (for oil wells) or equation W-17B to this section (for gas wells) for each well tested during the reporting year.

$$E_{a,n} = GOR * FR * D \quad \text{(Eq. W-17A)}$$


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$$E_{a,n} = PR * D \quad \text{(Eq. W-17B)}$$

Where:

$E_{a,n}$  = Annual volumetric natural gas emissions from well testing for each well being tested in cubic feet under actual conditions.

GOR = Gas to oil ratio in cubic feet of gas per barrel of oil for each well being tested; oil here refers to hydrocarbon liquids produced of all API gravities.

FR = Average annual flow rate in barrels of oil per day for the oil well being tested.

PR = Average annual production rate in actual cubic feet per day for the gas well being tested.

D = Number of days during the calendar year that the well is tested.

- (4) Calculate natural gas volumetric emissions at standard conditions using calculations in paragraph (t) of this section.
- (5) Calculate both CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions from natural gas volumetric emissions using calculations in paragraphs (u) and (v) of this section.

(m) **Associated gas venting and flaring.** Calculate CH<sub>4</sub> and CO<sub>2</sub> annual emissions from associated gas venting not in conjunction with well testing (refer to paragraph (l) of this section) as specified in paragraphs (m)(1) through (3) of this section. If emissions from associated gas venting are routed to a flare, you must

calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O annual emissions as specified in paragraph (n) of this section, report emissions from the flare as specified in § 98.236(n), and report additional information specified in § 98.236(m), as applicable.

- (1) If you measure the gas flow to a vent using a continuous flow measurement device, you must use the measured flow volumes to calculate vented associated gas emissions.
- (2) If you do not measure the gas flow to a vent using a continuous flow measurement device, you must follow the procedures in paragraphs (m)(2)(i) through (iii) of this section.
  - (i) Determine the GOR of the hydrocarbon production from each well whose associated natural gas is vented or flared. If GOR from each well is not available, use the GOR from a cluster of wells in the same sub-basin category.
  - (ii) If GOR cannot be determined from your available data, then you must use one of the procedures specified in paragraph (m)(2)(ii)(A) or (B) of this section to determine GOR.
    - (A) You may use an appropriate standard method published by a consensus-based standards organization if such a method exists.
    - (B) You may use an industry standard practice as described in § 98.234(b).
  - (iii) Estimate venting emissions using equation W-18 to this section.

$$E_{s,n,p} = (GOR_p \times V_p) - SG_p \quad (\text{Eq. W-18})$$

Where:

$E_{s,n,p}$  = Annual volumetric natural gas emissions at each well from associated gas venting at standard conditions, in cubic feet.

$GOR_p$  = Gas to oil ratio, for well p, in standard cubic feet of gas per barrel of oil determined according to paragraphs (m)(2)(i) through (iii) of this section; oil here refers to hydrocarbon liquids produced of all API gravities.

$V_p$  = Volume of oil produced, for well p, in barrels in the calendar year only during time periods in which associated gas was vented or flared.

$SG_p$  = Volume of associated gas sent to sales and volume of associated gas used for other purposes at the facility site, including powering engines, separators, safety systems and/or combustion equipment and not flared or vented, for well p, in standard cubic feet of gas in the calendar year only during time periods in which associated gas was vented or flared.

- (3) Calculate both CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions from volumetric natural gas emissions using calculations in paragraph (u) and (v) of this section.
- (n) **Flare stack emissions.** Except as specified in paragraph (n)(9) of this section, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each flare stack as specified in paragraphs (n)(1) through (8) of this section. For each flare, disaggregate the total flared emissions to applicable source types as specified in paragraph (n)(10) of this section.

- (1) ***Destruction efficiency and combustion efficiency.*** To calculate CH<sub>4</sub> emissions for flares, use the applicable default destruction and combustion efficiencies specified in paragraphs (n)(1)(i) through (iii) of this section or alternative destruction and combustion efficiencies determined in accordance with paragraph (n)(1)(v) of this section. If you change the method with which you determine the default destruction and combustion efficiencies during a year, then use the applicable destruction and combustion efficiencies in paragraphs (n)(1)(i) through (iii) and paragraph (n)(1)(v) of this section for each portion of the year during which a different default destruction and combustion efficiency was used, and calculate an annual time-weighted average destruction and combustion efficiency to report for the flare.
- (i) ***Tier 1.*** Use a default destruction efficiency of 98 percent and a default combustion efficiency of 96.5 percent if you follow the performance test requirements specified in paragraph (n)(1)(i)(A) of this section and the operating limit requirements specified in paragraph (n)(1)(i)(B) of this section, or the operating limit requirements specified in paragraph (n)(1)(i)(C) of this section, as applicable. You must also keep the applicable records in § 63.655(i)(2), (3), and (9) of this chapter. If you fail to fully conform with all cited provisions for a period of 15 consecutive days, you must utilize the Tier 3 default destruction and combustion efficiency values until such time that full conformance is achieved. You must document these periods and maintain records as specified in § 98.237 of the date when the non-conformance began, and the date when full conformance is re-established.
- (A) The applicable testing requirements in § 63.645(a), (b), (c), (d), and (i) of this chapter, including § 63.116 (a)(2), (3), (b), and (c) of this chapter. When § 63.645 refers to “organic HAP,” the terms “methane” and “CO<sub>2</sub>” shall apply for the purposes of this subpart.
- (B) The applicable monitoring requirements in § 63.644(a), (b), (d), and (e) of this chapter. The data to submit in a Notification of Compliance Status report in § 63.644(d) of this chapter shall be maintained as records for the purposes of this section (n)(1)(i), and references to violations in § 63.644(e) of this chapter do not apply for the purposes of this section (n)(1)(i).
- (C) The requirements in § 63.670 (a) through (n), § 63.670(p), and § 63.671 of this chapter.
- (ii) ***Tier 2.*** Use a default destruction efficiency of 95 percent and a default combustion efficiency of 93.5 percent if you follow the requirements specified in either paragraph (n)(1)(ii)(A), (B), (C), or (D) of this section. If you fail to fully conform with all cited provisions for a period of 15 consecutive days, you must utilize the Tier 3 default destruction and combustion efficiency values until such time that full conformance is achieved. You must document these periods and maintain records as specified in § 98.237 of the date when the non-conformance began, and the date when full conformance is re-established.
- (A) The requirements in § 60.5412b(a)(1) of this chapter, along with the applicable testing requirements in § 60.5413b(b) of this chapter, the applicable continuous compliance requirements in § 60.5415b(f) of this chapter, and the applicable continuous monitoring requirements in § 60.5417b of this chapter. You must also keep the applicable records in § 60.5420b(c)(11) of this chapter.
- (B) The requirements in § 60.5412b(a)(3) of this chapter, the applicable continuous compliance requirements in § 60.5415b(f) of this chapter, and the applicable continuous monitoring requirements in § 60.5417b of this chapter. You must also keep the applicable records in § 60.5420b(c)(11) of this chapter.

- (C) If using an enclosed combustion device tested by the manufacturer in accordance with § 60.5413b(d) of this chapter, the requirements in § 60.5413b(b)(5)(iii) and (e) of this chapter, the applicable continuous compliance requirements in § 60.5415b(f) of this chapter, and the applicable continuous monitoring requirements in § 60.5417b of this chapter. You must also keep the applicable records in § 60.5420b(c)(11) of this chapter.
  - (D) If you are subject to an approved state plan or applicable Federal plan in part 62 of this chapter that requires the reduction of methane by 95 percent, you may follow all applicable requirements of the approved state plan or applicable Federal plan in part 62 of this chapter, including the testing, continuous compliance, continuous monitoring, and recordkeeping requirements.
- (iii) **Tier 3.** Use a default destruction efficiency of 92 percent and a default combustion efficiency of 90.5 percent if you do not meet the requirements specified in either paragraph (n)(1)(i) or (ii) of this section.
- (iv) **Alternative test method.** If you are utilizing the tier 2 default efficiencies in paragraph (n)(2)(ii) of this section and are not subject to 40 CFR subpart 0000b or an applicable approved state or applicable federal plan under part 62 of this chapter that requires 95 percent reduction in methane emissions, you may conduct a performance test using EPA OTM-52 (incorporated by reference, see § 98.7) as an alternative to conducting a performance test using the methods specified in § 60.5413b of this chapter, or in an applicable approved state plan or applicable Federal plan in part 62 of this chapter. If the combustion efficiency obtained using OTM-52 is equal to or greater than 93.5 percent, then use a default destruction efficiency of 95 percent and a default combustion efficiency of 93.5 percent. If you utilize OTM-52 for the testing, you must comply with all the applicable monitoring, compliance, and recordkeeping requirements identified in paragraph (n)(1)(ii) of this section.
- (v) **Alternative destruction and combustion efficiencies.** You may use a directly measured combustion efficiency instead of the default combustion efficiencies specified in paragraphs (n)(1)(i) through (iii) of this section if you follow the provisions of paragraph (n)(1)(v)(A) through (E) of this section.
- (A) Measure the combustion efficiency in accordance with an alternative test method approved in accordance with § 60.5412b(d) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter.
  - (B) Conduct monitoring as specified in §§ 60.5415b(f)(1)(x) and (xi) and 60.5417b(i) of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter.
  - (C) Adhere to all conditions in the monitoring plan you prepare as specified in § 60.5417b(i)(2) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter at all times.
  - (D) You must use a destruction efficiency equal to the combustion efficiency plus 1.5.
  - (E) If you fail to fully conform with your plan for a period of 15 or more consecutive days, you must utilize the Tier 3 default destruction and combustion efficiency values until such time that full conformance is achieved. You must document these periods and maintain records as specified in § 98.237 of the date when the non-conformance began, and the date when full conformance is re-established.

- (2) **Pilot.** Continuously monitor for the presence of a pilot flame or combustion flame as specified in paragraph (n)(2)(i) of this section or visually inspect for the presence of a pilot flame or combustion flame as specified in paragraph (n)(2)(ii) of this section, as applicable.. If you comply with tier 2, you must also use data collected according to paragraph (n)(2)(iii) of this section in your calculations of time the flare was unlit and the fraction of gas routed to the flare during periods when the flare was unlit. If you continuously monitor, then periods when the flare is unlit must be determined based on those data, except when contradicted by data collected according to paragraph (n)(2)(iii) of this section. Determine the fraction of the total volume that is routed to the flare during unlit periods as specified in paragraph (n)(2)(iv) of this section.
- (i) At least once every five minutes monitor for the presence of a pilot flame or combustion flame using a device (including, but not limited to, a thermocouple, ultraviolet beam sensor, infrared sensor, video surveillance system, or advanced remote monitoring method) capable of detecting that the pilot or combustion flame is present at all times.
- (A) Monitoring for the presence of a flare flame in accordance with § 60.5417b satisfies the requirement of this paragraph (n)(2).
- (B) You may use multiple or redundant monitoring devices. When a discrepancy occurs between multiple devices, you must either visually confirm or use video surveillance output to confirm that the flame is present as soon as practicable after detecting the discrepancy to ensure that at least one device is operating properly. If you confirm that at least one device is operating properly, you may rely on the properly operating device(s) to monitor the flame.
- (C) Continuous monitoring systems used for the presence of a pilot flame or combustion flame are not subject to a minimum accuracy requirement beyond being able to detect the presence or absence of a flame and are exempt from the calibration requirements of this part 98.
- (D) Track the length of time over all periods when the flare is unlit and calculate the fraction of the total flow to the flare that was routed to the flare when the flare was unlit as specified in paragraph (n)(2)(iv) of this section.
- (E) If all continuous monitoring devices are out of service for more than one week, then visually inspect for the presence of a pilot flame or combustion flame at least once per week for the first 4 weeks that the monitoring devices are out of service or until at least one repaired or new device is operational, whichever period is shorter. If all continuous monitoring devices are out of service for less than one week, then at least one visual inspection must be conducted during the outage. If a flame is not detected during a weekly visual inspection, assume the pilot has been unlit since the previous inspection or the last time the continuous monitoring device detected a flame, and assume that the pilot remains unlit until a subsequent inspection or continuous monitoring device detects a flame. If the monitoring device outage lasts more than 4 weeks, then you may switch to conducting inspections at least once per month in accordance with paragraph (n)(2)(ii) of this section.
- (ii) As an alternative to continuous monitoring as specified in paragraph (n)(2)(i) of this section, if you comply with tier 3 in paragraph (n)(1)(iii) of this section, at least once per month visually inspect for the presence of a pilot flame or combustion flame. You may also conduct visual inspections when using an alternative test method in accordance with paragraph (n)(1)(iv) of

this section that allows visual inspections. If a flame is not detected, track the time since the previous inspection until a subsequent inspection detects a flame, and use this time in your calculation of the fraction of the total flow to the flare that was routed to the flare when the flare was unlit as specified in paragraph (n)(2)(iv) of this section. Use the sum of the measured flows, as determined from measurements obtained under paragraph (n)(1) of this section, during all time periods when the pilot was determined to be unlit, to calculate the fraction of the total annual volume that is routed to the flare when it is unlit.

- (iii) For a flare subject to 40 CFR part 60 subpart OOOOb, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, a flare inspection conducted using an OGI camera during a fugitive emissions survey in accordance with § 60.5415b(f)(1)(x) constitutes a pilot flame inspection under this subpart. If a flame is not detected, track the time from the previous inspection until a subsequent inspection or continuous monitoring device detects a flame and use this time in your calculation of the fraction of the total flow to the flare that was routed to the flare when the flare was unlit as specified in paragraph (n)(2)(iv) of this section.
  - (iv) If you measure total flow to the flare in accordance with paragraph (n)(3)(i) of this section, calculate the fraction of the total annual volume that is routed to the flare when it is unlit using the actual flow during the unlit time periods that are tracked according to paragraph (n)(2)(i)(D), (ii), or (iii) of this section. If you determine flows of individual streams routed to the flare in accordance with paragraph (n)(3)(ii) of this section, use the stream-specific average flow rates for the streams routed to the flare during unlit times to calculate the fraction of the total annual volume that is routed to the flare when it is unlit.
- (3) **Flow determination.** Calculate total flow to the flare as specified in paragraph (n)(3)(i) of this section or determine flow of each individual stream that is routed to the flare as specified in paragraph (n)(3)(ii) of this section. Use engineering calculations based on best available data and company records to calculate pilot gas flow to add to the total gas flow to the flare.
- (i) Use a continuous parameter monitoring system to measure flow of gas to the flare downstream of any sweep, purge, or auxiliary gas addition. You may use either flow meters or indirectly calculate flow using other parameter monitoring systems combined with engineering calculations, such as line pressure, line size, and burner nozzle dimensions. If you use a continuous parameter monitoring system, you must use the measured flow in calculating the total flow volume to the flare. The continuous parameter monitoring system must measure data values at least once every hour.
  - (ii) Determine flow to the flare from individual sources, including sweep, purge, auxiliary fuel, and collective flow from offsite sources that route gas to the flare using any combination of the methods in paragraphs (n)(3)(ii)(A) and (B) of this section, as applicable. Adjust the volumes determined as specified in paragraphs (n)(3)(ii)(A) and (B) of this section by any estimated bypass volumes diverted from entering the flare and leaks from the closed vent system in accordance with paragraphs (n)(3)(ii)(C) and (D) of this section. Do not adjust the volumes routed to the flare for volumes diverted through bypass lines located upstream of the flow measurement or determination location.
    - (A) Use a continuous flow meter to measure the flow of gas from individual sources (or combination of sources) that route gas to the flare. If the emission streams for multiple sources are routed to a manifold before being combined with other emission streams, you may conduct the measurement in the manifold instead of from each source that is routed



to the manifold. If you use a continuous flow meter, you must use the measured flow in calculating the total flow volume to the flare. The continuous flow meter must measure data values at least once every hour.

- (B) If flow from a source is not measured using a continuous flow meter, then use methods specified in paragraphs (n)(3)(ii)(B)(1) through (8) of this section, as applicable.
  - (1) Determine flow of emission streams routed to flares from acid gas removal units using Calculation Method 3 or Calculation Method 4 as specified in paragraph (d)(3) or (4) of this section. Use the method specified in paragraph (n)(3)(ii)(B)(8) of this section to determine the volume of non-GHG constituents in a stream from an acid gas removal unit or nitrogen removal unit and add to the volume of GHGs to determine the total volume to the flare.
  - (2) Determine flow of emission streams routed to flares from dehydrators using an applicable method specified in paragraph (e) of this section. When using Calculation Method 2 to determine volume of GHGs from small glycol dehydrators, also use the method specified in paragraph (n)(3)(ii)(B)(8) of this section to determine the volume of non-GHG constituents in the stream to the flare and add to the volume of GHGs to determine the total volume to the flare.
  - (3) Determine flow of emission streams routed to flares from completions and workovers with hydraulic fracturing using a method specified in paragraph (g) of this section.
  - (4) Determine flow of emission streams routed to flares from completions and workovers without hydraulic fracturing using a method specified in paragraph (h) of this section.
  - (5) Determine flow of emission streams routed to flares from hydrocarbon liquids and produced water storage tanks using a method specified in paragraph (j) of this section. When using Calculation Method 2 or Calculation Method 3 to calculate the volume of GHGs, use the method specified in paragraph (n)(3)(ii)(B)(8) of this section to determine the volume of non-GHG constituents in the stream to the flare and add to the volume of GHGs to determine the total volume to the flare.
  - (6) Determine flow of emission streams routed to flares from well testing using an applicable method specified in paragraph (l) of this section.
  - (7) Determine flow of associated gas emission streams routed to flares using the method specified in paragraph (m)(2) of this section.
  - (8) Use engineering calculations based on process knowledge, company records, and best available data to calculate flow for sources other than those described in paragraphs (n)(3)(ii)(B)(1) through (7) of this section and to calculate volume of non-GHG constituents in streams for which the method used in paragraphs (n)(3)(ii)(B)(1), (2), and (5) of this section calculates only the GHG flow.
- (C) If the closed vent system that routes emissions to the flare contains one or more bypass devices that could be used to divert all or a portion of the gases from entering the flare, then you must determine when flow is diverted through the bypass and estimate the volume that bypasses the flare. The bypass volume may be determined based on

engineering calculations, process knowledge, and best available data. Use the estimated bypass volume to adjust the volumes determined in accordance with paragraph (n)(3)(ii)(A) or (B) of this section to determine the flow to the flare. For bypass volumes that are diverted directly to atmosphere, use the estimated volume in the calculation and reporting of vented emissions from the applicable source(s).

- (D) If you determine a component in the closed vent system is leaking, you must adjust the flow determined in accordance with paragraph (n)(3)(ii)(A) or (B) of this section by the estimated volume of the leak to determine the flow to the flare. Estimate the leak volume based on engineering calculations, process knowledge, and best available data. Report the estimated leak volume as vented emissions from the applicable source(s).

(4) **Gas composition.** Determine the composition of the inlet gas to the flare as specified in either paragraph (n)(4)(i) or (ii) of this section, or determine composition of the individual streams that are combined and routed to the flare as specified in paragraph (n)(4)(iii) of this section. Use representative compositions of pilot gas determined by engineering calculation based on process knowledge and best available data.

- (i) Use a continuous gas composition analyzer on the inlet gas to the flare burner downstream of any purge, sweep, or auxiliary fuel addition to measure annual average mole fractions of methane, ethane, propane, butane, pentanes plus, and CO<sub>2</sub>. If you use a continuous gas composition analyzer on the total inlet stream to the flare, you must use the measured annual average mole fractions to calculate total emissions from the flare. The continuous gas composition analyzer must measure data values at least once every hour.
- (ii) Take samples of the inlet gas to the flare burner downstream of any purge, sweep, or auxiliary fuel addition at least annually in which gas is routed to the flare and analyze for methane, ethane, propane, butane, pentanes plus, and CO<sub>2</sub> constituents. Determine the annual average concentration of each constituent as the annual average of all valid measurements for that constituent during the year and you must use those data to calculate flared emissions.
- (iii) When composition is not determined at the inlet to the flare as specified in either paragraph (i) or (ii) of this section, then determine annual average compositions for streams from individual sources (or combinations of sources), including sweep, purge, and auxiliary fuel, routed to the flare using any combination of the methods specified in paragraphs (n)(4)(iii)(A) and (B) of this section, as applicable.
  - (A) Use a continuous gas composition analyzer to measure annual average mole fractions of methane, ethane, propane, butane, pentanes plus, and CO<sub>2</sub> constituents. If emission streams for multiple sources are routed to a manifold before being combined with other emission streams, you may measure gas composition in the manifold instead of from each source that is routed to the manifold. If you use a continuous gas composition analyzer, you must use the measured annual average mole fractions to calculate flared emissions for the stream. The continuous gas composition analyzer must measure data values at least once every hour.
  - (B) If composition is not measured in accordance with paragraph (n)(4)(iii)(A) of this section, then use methods specified in paragraphs (n)(4)(iii)(B)(1) through (7) of this section to determine composition, as applicable. When paragraphs (n)(4)(iii)(B)(1) through (5) reference continuous gas composition analyzer requirements in paragraph (u)(2) of this section, the requirements in paragraph (n)(4)(iii)(A) apply for the purposes of this

paragraph (n)(4)(iii)(B). When paragraphs (n)(4)(iii)(B)(1) through (5) reference paragraph (u)(2) of this section, the language “your most recent available analysis” in paragraph (u)(2)(i) of this section means “annual samples” for the purposes of this paragraph (n)(4)(iii)(B).

- (1) Determine the total annual average GHG composition of streams from acid gas removal units based on either process simulation as specified in paragraph (d)(4) of this section or quarterly sampling in accordance with paragraphs (d)(6) and (10) of this section, and determine the composition of ethane, propane, butane, and pentanes plus as specified in paragraph (n)(4)(iii)(B)(5) of this section.
- (2) Determine the total annual average composition of streams from glycol dehydrators using Calculation Method 1 as specified in paragraph (e)(1) of this section or determine the annual average GHG composition as specified in paragraph (u)(2) of this section for the applicable industry segment. Determine annual average GHG composition of streams from desiccant dehydrators as specified in paragraph (u)(2) of this section. If you determine GHG composition in accordance with paragraph (u)(2) of this section, also determine the composition of ethane, propane, butane, and pentanes plus as specified in paragraph (n)(4)(iii)(B)(5) of this section.
- (3) Determine the total annual average composition of streams from hydrocarbon liquids and produced water storage tanks using Calculation Method 1 in accordance with paragraph (j)(1) of this section or determine the annual average GHG composition as specified in paragraph (u)(2)(i) of this section. If you determine annual average GHG composition as specified in paragraph (u)(2)(i) of this section, then also determine the composition of ethane, propane, butane, and pentanes plus as specified in paragraph (n)(4)(iii)(B)(5) of this section.
- (4) For onshore natural gas processing facilities, determine GHG mole fractions for all emission sources downstream of the de-methanizer overhead or dew point control based on samples of facility-specific residue gas to transmission pipeline systems taken at least once per year according to methods set forth in § 98.234(b), and determine GHG mole fractions for all emission sources upstream of the de-methanizer or dew point control based on samples of feed natural gas taken at least once per year according to methods set forth in § 98.234(b). For onshore natural gas processing plants that solely fractionate a liquid stream, use the GHG mole fraction in feed natural gas liquid streams as determined from samples taken at least once per year. If multiple samples of a stream are taken in a year, use the arithmetic average GHG composition.
- (5) Except as specified in paragraph (n)(4)(iii)(B)(6) of this section, for streams from any source type other than those identified in paragraphs (n)(4)(iii)(B)(1) through (4) of this section, and for purge gas, sweep gas, and auxiliary fuel, determine the annual average GHG composition as specified in paragraph (u)(2) of this section for the applicable industry segment, and determine the composition of ethane, propane, butane, and pentanes plus as specified in paragraph (n)(4)(iii)(B)(7) of this section.
- (6) When the stream going to the flare is a hydrocarbon product stream, such as methane, ethane, propane, butane, pentanes-plus, or mixed light hydrocarbons, you may use a representative composition from the source for the stream determined by engineering calculation based on process knowledge and best available data.

(7) When only the GHG composition is determined in accordance with paragraph (u)(2) of this section, determine the annual average composition of ethane, propane, butane, and pentanes plus in the stream using a representative composition based on process knowledge and best available data.

(5) **Calculate CH<sub>4</sub> and CO<sub>2</sub> emissions.** Calculate GHG volumetric emissions from flaring at standard conditions using equations W-19 and W-20 to this section and as specified in paragraphs (n)(5)(i) through (iv) of this section.

$$E_{s,CH_4} = V_s \times X_{CH_4} \times [(1 - \eta_D) \times Z_L + Z_U] \quad (\text{Eq. W-19})$$

$$E_{s,CO_2} = V_s \times X_{CO_2} + \sum_{j=1}^5 (\eta_C \times V_s \times Y_j \times R_j \times Z_L) \quad (\text{Eq. W-20})$$

Where:

$E_{s,CH_4}$  = Annual CH<sub>4</sub> emissions from flare stack in cubic feet, at standard conditions.

$E_{s,CO_2}$  = Annual CO<sub>2</sub> emissions from flare stack in cubic feet, at standard conditions.

$V_s$  = Volume of gas sent to flare in standard cubic feet, during the year as determined in paragraph (n)(3) of this section.

$\eta_D$  = Flare destruction efficiency, expressed as fraction of hydrocarbon compounds in gas that is destroyed by a burning flare, but may or may not be completely oxidized to CO<sub>2</sub>.

$\eta_C$  = Flare combustion efficiency, expressed as fraction of hydrocarbon compounds in gas that is oxidized to CO<sub>2</sub> by a burning flare.

$X_{CH_4}$  = Annual average mole fraction of CH<sub>4</sub> in the feed gas to the flare or in each of the streams routed to the flare as determined in paragraph (n)(4) of this section.

$X_{CO_2}$  = Annual average mole fraction of CO<sub>2</sub> in the feed gas to the flare or in each of the streams routed to the flare as determined in paragraph (n)(4) of this section.

$Z_U$  = Fraction of the feed gas sent to an un-lit flare determined from both the total time the flare was unlit as determined by monitoring the pilot flame or combustion flame as specified in paragraph (n)(2) of this section and the volume of gas routed to the flare during periods when the flare was unlit based on the flow determined in accordance with paragraph (n)(3) of this section.

$Z_L$  = Fraction of the feed gas sent to a burning flare (equal to 1– $Z_U$ ).

$Y_j$  = Annual average mole fraction of hydrocarbon constituents  $j$  (such as methane, ethane, propane, butane, and pentanes-plus) in the feed gas to the flare or in each of the streams routed to the flare as determined in paragraph (n)(4) of this section.

$R_j$  = Number of carbon atoms in the hydrocarbon constituent  $j$  in the feed gas to the flare: 1 for methane, 2 for ethane, 3 for propane, 4 for butane, and 5 for pentanes-plus).

- (i) If you measure the gas flow at the flare inlet as specified in paragraph (n)(3)(i) of this section and you measure gas composition for the inlet gas to the flare as specified in paragraph (n)(4)(i) or (ii) of this section, then use those data in equations W-19 and W-20 to this section to calculate total emissions from the flare.
  - (ii) If you determine the flow from each source as specified in paragraph (n)(3)(ii) of this section and you measure gas composition for the inlet gas to the flare as specified in paragraph (n)(4)(i) or (ii) of this section, then sum the flows for each stream to calculate the total annual gas flow to the flare. Use that total annual flow with the annual average concentration of each constituent as calculated in paragraph (n)(4)(i) or (ii) of this section in equations W-19 and W-20 to this section to calculate total emissions from the flare.
  - (iii) If you determine the flow from each source as specified in paragraph (n)(3)(ii) of this section and you determine gas composition for the emission stream from each source as specified in paragraph (n)(4)(iii) of this section, then calculate total emissions from the flare as specified in either paragraph (n)(5)(iii)(A) or (B) of this section.
    - (A) Use each set of stream-specific flow and annual average concentration data in equations W-19 and W-20 to this section to calculate stream-specific flared emissions for each stream, and then sum the results from each stream-specific calculation to calculate the total emissions from the flare.
    - (B) Sum the flows from each source to calculate the total gas flow into the flare and use the source-specific flows and source-specific annual average concentrations to determine flow-weighted annual average concentrations of CO<sub>2</sub> and hydrocarbon constituents in the combined gas stream into the flare. Use the calculated total gas flow and the calculated flow-weighted annual average concentrations for the inlet gas stream to the flare in equations W-19 and W-20 to this section to calculate the total emissions from the flare.
  - (iv) You may not combine measurement of the inlet gas flow to the flare as specified in paragraph (n)(3)(i) of this section with measurement of the gas composition of the streams from each source as specified in paragraph (n)(4)(iii) of this section.
- (6) **Convert volume at actual conditions to volume at standard conditions.** Convert GHG volumetric emissions to standard conditions using calculations in paragraph (t) of this section.
  - (7) **Convert volumetric emissions to mass emissions.** Calculate both CH<sub>4</sub> and CO<sub>2</sub> mass emissions from volumetric emissions using calculation in paragraph (v) of this section.
  - (8) **Calculate N<sub>2</sub>O emissions.** Calculate N<sub>2</sub>O emissions from flare stacks using equation W-40 to this section. Determine the values of parameters “HHV” and “Fuel” in equation W-40 to this section as specified in paragraphs (n)(8)(i) through (iv) of this section, as applicable.
    - (i) Directly measure the annual average higher heating value in the inlet stream to the flare using either a continuous gas composition analyzer or a calorimeter. Use this flare-specific annual average higher heating value for the parameter “HHV” in equation W-40 to this section, and use either the total inlet flow to the flare measured as specified in paragraph (n)(3)(i) of this section

or the sum of the flows of individual streams routed to the flare as determined in paragraph (n)(3)(ii) of this section for the parameter “Fuel” in equation W-40 to this section to calculate the total N<sub>2</sub>O emissions from the flare.

- (ii) Calculate the annual average higher heating value in the inlet stream to the flare using annual average gas compositions of the inlet stream measured in accordance with paragraph (n)(4)(i) or (ii) of this section. Use this flare-specific annual average higher heating value for the parameter “HHV” in equation W-40 to this section, and use either the total inlet flow to the flare measured as specified in paragraph (n)(3)(i) of this section or the sum of the flows of individual streams routed to the flare as determined in paragraph (n)(3)(ii) of this section for the parameter “Fuel” in equation W-40 to this section to calculate the total N<sub>2</sub>O emissions from the flare.
- (iii) Directly measure the annual average higher heating values in the individual streams routed to the flare using either a continuous gas composition analyzer or a calorimeter. Calculate the total N<sub>2</sub>O emissions from the flare as specified in either paragraph (n)(8)(iii)(A) or (B) of this section.
  - (A) Use the stream-specific annual average higher heating values for the parameter “HHV” in equation W-40 to this section, use the stream-specific flows as determined in paragraph (n)(3)(ii) of this section for the parameter “Fuel” in equation W-40 to this section in separate stream-specific calculations of N<sub>2</sub>O emissions using equation W-40 to this section, and sum the resulting values to calculate the total N<sub>2</sub>O emissions from the flare.
  - (B) Use the stream-specific annual average higher heating values and flows to calculate a flow-weighted annual average higher heating value to use as the parameter “HHV” in equation W-40 to this section and the sum of the individual stream flows routed to the flare as determined in paragraph (n)(3)(ii) of this section for the parameter “Fuel” in equation W-40 to this section to calculate total N<sub>2</sub>O emissions from the flare.
- (iv) Calculate annual average higher heating values for the individual streams routed to the flare using gas compositions determined in accordance with paragraph (n)(4)(iii) of this section. Calculate the total N<sub>2</sub>O emissions from the flare as specified in either paragraph (n)(8)(iv)(A) or (B) of this section.
  - (A) Use the stream-specific annual average higher heating values and the stream-specific flows in separate stream-specific calculations of N<sub>2</sub>O emissions using equation W-40 to this section and sum the resulting values to calculate the total N<sub>2</sub>O emissions from the flare.
  - (B) Use the stream-specific annual average higher heating values and flows to calculate a flow-weighted annual average higher heating value to use as the parameter “HHV” in equation W-40 to this section and the sum of the individual stream flows routed to the flare as determined in paragraph (n)(3)(ii) of this section for the parameter “Fuel” in equation W-40 to this section to calculate total N<sub>2</sub>O emissions from the flare.
- (9) **CEMS.** If you operate and maintain a CEMS that has both a CO<sub>2</sub> concentration monitor and volumetric flow rate monitor for the combustion gases from the flare, you must calculate CO<sub>2</sub> emissions for the flare using the CEMS. You must follow the Tier 4 Calculation Method and all associated calculation, quality assurance, reporting, and recordkeeping requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources). If a CEMS is used to calculate

flare stack CO<sub>2</sub> emissions, you must also comply with all other requirements specified in paragraphs (n)(1) through (8) of this section, except that calculation of CO<sub>2</sub> emissions using equation W-20 to this section is not required.

(10) **Disaggregation.** Disaggregate the total emissions from the flare as calculated in paragraphs (n)(7) and (8) of this section or paragraph (n)(9) of this section, as applicable, to each source type listed in paragraphs (n)(10)(i) through (viii) of this section, as applicable to the industry segment, that routed emissions to the flare. If emissions from the flare are calculated in accordance with paragraph (n)(5)(iii) of this section using stream-specific flow and composition, including combined streams that contain emissions from only a single source type, use the source-specific emissions calculated using these data to calculate the disaggregated emissions per source type. If the total emissions from the flare are calculated using total flow and/or total annual average composition of the total inlet stream to the flare, or if flow or composition are determined for a combined stream that contains emissions from more than one source type, then use engineering calculations and best available data to disaggregate the total emissions to the applicable source types.

(i) Acid gas removal units.

(ii) Dehydrators.

(iii) Completions and workovers with hydraulic fracturing.

(iv) Completions and workovers without hydraulic fracturing.

(v) Hydrocarbon liquids and produced water storage tanks.

(vi) Well testing.

(vii) Associated gas.

(viii) Other (collectively).

(o) **Centrifugal compressor venting.** If you are required to report emissions from centrifugal compressor venting as specified in § 98.232(d)(2), (e)(2), (f)(2), (g)(2), and (h)(2), you must conduct volumetric emission measurements specified in paragraph (o)(1) of this section using methods specified in paragraphs (o)(2) through (5) of this section; perform calculations specified in paragraphs (o)(6) through (9) of this section; and calculate CH<sub>4</sub> and CO<sub>2</sub> mass emissions as specified in paragraph (o)(11) of this section. If you are required to report emissions from centrifugal compressor venting at an onshore petroleum and natural gas production facility as specified in § 98.232(c)(19) or an onshore petroleum and natural gas gathering and boosting facility as specified in § 98.232(j)(8), you must calculate volumetric emissions as specified in paragraph (o)(10) of this section and calculate CH<sub>4</sub> and CO<sub>2</sub> mass emissions as specified in paragraph (o)(11) of this section. If emissions from a compressor source are routed to a flare, paragraphs (o)(1) through (11) of this section do not apply and instead you must calculate CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n). If emissions from a compressor source are routed to combustion, paragraphs (o)(1) through (11) of this section do not apply and instead you must calculate and report emissions as specified in subpart C of this part or paragraph (z) of this section, as applicable. If emissions from a compressor source are routed to a vapor recovery system, paragraphs (o)(1) through (11) of this section do not apply.

(1) General requirements for conducting volumetric emission measurements. You must conduct volumetric emission measurements on each centrifugal compressor as specified in this paragraph. Compressor sources (as defined in § 98.238) without manifolded vents must use a measurement

method specified in paragraph (o)(1)(i) or (ii) of this section. Manifolded compressor sources (as defined in § 98.238) must use a measurement method specified in paragraph (o)(1)(i), (ii), (iii), or (iv) of this section.

- (i) **Centrifugal compressor source as found measurements.** Measure venting from each compressor according to either paragraph (o)(1)(i)(A), (B), or (C) of this section at least once annually, based on the compressor mode (as defined in § 98.238) in which the compressor was found at the time of measurement, except as specified in paragraph (o)(1)(i)(D) of this section. If additional measurements beyond the required annual testing are performed (including duplicate measurements or measurement of additional operating modes), then all measurements satisfying the applicable monitoring and QA/QC that is required by this paragraph (o) must be used in the calculations specified in this section.
  - (A) For a compressor measured in operating-mode, you must measure volumetric emissions from blowdown valve leakage through the blowdown vent as specified in paragraph (o)(2)(i) of this section, measure volumetric emissions from wet seal oil degassing vents as specified in paragraph (o)(2)(ii) of this section if the compressor has wet seal oil degassing vents, and measure volumetric emissions from dry seal vents as specified in paragraph (o)(2)(iii) of this section if the compressor has dry seals.
  - (B) For a compressor measured in not-operating-depressurized-mode, you must measure volumetric emissions from isolation valve leakage as specified in paragraph (o)(2)(i) of this section. If a compressor is not operated and has blind flanges in place throughout the reporting period, measurement is not required in this compressor mode.
  - (C) For a compressor measured in standby-pressurized-mode, you must measure volumetric emissions from blowdown valve leakage through the blowdown vent as specified in paragraph (o)(2)(i) of this section, measure volumetric emissions from wet seal oil degassing vents as specified in paragraph (o)(2)(ii) of this section if the compressor has wet seal oil degassing vents, and measure volumetric emissions from dry seal vents as specified in paragraph (o)(2)(iii) of this section if the compressor has dry seals.
  - (D) An annual as found measurement is not required in the first year of operation for any new compressor that begins operation after as found measurements have been conducted for all existing compressors. For only the first year of operation of new compressors, calculate emissions according to paragraph (o)(6)(ii) of this section.
- (ii) **Centrifugal compressor source continuous monitoring.** Instead of measuring the compressor source according to paragraph (o)(1)(i) of this section for a given compressor, you may elect to continuously measure volumetric emissions from a compressor source as specified in paragraph (o)(3) of this section.
- (iii) **Manifolded centrifugal compressor source as found measurements.** For a compressor source that is part of a manifolded group of compressor sources (as defined in § 98.238), instead of measuring the compressor source according to paragraph (o)(1)(i), (ii), or (iv) of this section, you may elect to measure combined volumetric emissions from the manifolded group of compressor sources by conducting measurements at the common vent stack as specified in paragraph (o)(4) of this section. The measurements must be conducted at the frequency specified in paragraphs (o)(1)(iii)(A) and (B) of this section.
  - (A) A minimum of one measurement must be taken for each manifolded group of compressor sources in a calendar year.



- (B) The measurement may be performed while the compressors are in any compressor mode.
- (iv) **Manifolded centrifugal compressor source continuous monitoring.** For a compressor source that is part of a manifolded group of compressor sources, instead of measuring the compressor source according to paragraph (o)(1)(i), (ii), or (iii) of this section, you may elect to continuously measure combined volumetric emissions from the manifolded group of compressor sources as specified in paragraph (o)(5) of this section.
- (2) **Methods for performing as found measurements from individual centrifugal compressor sources.** If conducting measurements for each compressor source, you must determine the volumetric emissions from blowdown valves and isolation valves as specified in paragraph (o)(2)(i) of this section, the volumetric emissions from wet seal oil degassing vents as specified in paragraph (o)(2)(ii) of this section, and the volumetric emissions from dry seal vents as specified in paragraph (o)(2)(iii) of this section.
  - (i) For blowdown valves on compressors in operating-mode or in standby-pressurized-mode and for isolation valves on compressors in not-operating-depressurized-mode, determine the volumetric emissions using one of the methods specified in paragraphs (o)(2)(i)(A) through (D) of this section.
    - (A) Determine the volumetric flow at standard conditions from the blowdown vent using calibrated bagging or high volume sampler according to methods set forth in § 98.234(c) and § 98.234(d), respectively.
    - (B) Determine the volumetric flow at standard conditions from the blowdown vent using a temporary meter such as a vane anemometer according to methods set forth in § 98.234(b).
    - (C) Use an acoustic leak detection device according to methods set forth in § 98.234(a)(5).
    - (D) You may choose to use any of the methods set forth in § 98.234(a) to screen for emissions. If emissions are detected using the methods set forth in § 98.234(a), then you must use one of the methods specified in paragraph (o)(2)(i)(A) through (C) of this section. If emissions are not detected using the methods in § 98.234(a), then you may assume that the volumetric emissions are zero. For the purposes of this paragraph, when using any of the methods in § 98.234(a), emissions are detected whenever a leak is detected according to the methods.
  - (ii) For wet seal oil degassing vents in operating-mode or in standby-pressurized-mode, determine volumetric flow at standard conditions, using one of the methods specified in paragraphs (o)(2)(ii)(A) through (C) of this section. You must quantitatively measure the volumetric flow for wet seal oil degassing vent; you may not use screening methods set forth in § 98.234(a) to screen for emissions for the wet seal oil degassing vent.
    - (A) Use a temporary meter such as a vane anemometer or permanent flow meter according to methods set forth in § 98.234(b).
    - (B) Use calibrated bags according to methods set forth in § 98.234(c).
    - (C) Use a high volume sampler according to methods set forth in § 98.234(d).

- (iii) For dry seal vents in operating-mode or in standby-pressurized-mode, determine volumetric flow at standard conditions from each dry seal vent using one of the methods specified in paragraphs (o)(2)(iii)(A) through (D) of this section. The measurement should be conducted on the compressor side dry seal. If a compressor has more than one dry seal vent, determine the aggregate dry seal vent volumetric flow for the compressor as the sum of the volumetric flows determined for each dry seal vent on the compressor.
  - (A) Use a temporary meter such as a vane anemometer or permanent flow meter according to methods set forth in § 98.234(b).
  - (B) Use calibrated bags according to methods set forth in § 98.234(c).
  - (C) Use a high volume sampler according to methods set forth in § 98.234(d).
  - (D) You may choose to use any of the methods set forth in § 98.234(a)(1) through (3) to screen for emissions. If emissions are detected using one of these specified methods, then you must use one of the methods specified in paragraph (o)(2)(iii)(A) through (C) of this section. If emissions are not detected using the methods in § 98.234(a)(1) through (3), then you may assume that the volumetric emissions are zero. For the purposes of this paragraph, when using any of the methods in § 98.234(a), emissions are detected whenever a leak is detected according to the methods. Acoustic leak detection is only applicable for through-valve leakage and is not applicable for screening dry seal vents.
- (3) **Methods for continuous measurement from individual centrifugal compressor sources.** If you elect to conduct continuous volumetric emission measurements for an individual compressor source as specified in paragraph (o)(1)(ii) of this section, you must measure volumetric emissions as specified in paragraphs (o)(3)(i) and (ii) of this section.
  - (i) Continuously measure the volumetric flow for the individual compressor source at standard conditions using a permanent meter according to methods set forth in § 98.234(b).
  - (ii) If compressor blowdown emissions are included in the metered emissions specified in paragraph (o)(3)(i) of this section, the compressor blowdown emissions may be included with the reported emissions for the compressor source and do not need to be calculated separately using the method specified in paragraph (i) of this section for blowdown vent stacks.
- (4) **Methods for performing as found measurements from manifolded groups of centrifugal compressor sources.** If conducting measurements for a manifolded group of compressor sources, you must measure volumetric emissions as specified in paragraphs (o)(4)(i) and (ii) of this section.
  - (i) Measure at a single point in the manifold downstream of all compressor inputs and, if practical, prior to comingling with other non-compressor emission sources.
  - (ii) Determine the volumetric flow at standard conditions from the common stack using one of the methods specified in paragraphs (o)(4)(ii)(A) through (F) of this section.
    - (A) A temporary meter such as a vane anemometer according the methods set forth in § 98.234(b).
    - (B) Calibrated bagging according to methods set forth in § 98.234(c).
    - (C) A high volume sampler according to methods set forth § 98.234(d).
    - (D) [Reserved]

- (E) You may choose to use any of the methods set forth in § 98.234(a)(1) through (3) to screen for emissions. If emissions are detected using one of these methods, then you must use one of the methods specified in paragraph (o)(4)(ii)(A) through (D) of this section. If emissions are not detected using the methods in § 98.234(a)(1) through (3), then you may assume that the volumetric emissions are zero. For the purposes of this paragraph, when using any of the methods in § 98.234(a), emissions are detected whenever a leak is detected according to the method. Acoustic leak detection is only applicable for through-valve leakage and is not applicable for screening a manifolded group of compressor sources.
  - (F) If one of the screening methods specified in § 98.234(a)(1) through (3) identifies a leak in a manifolded group of centrifugal compressor sources, you may use acoustic leak detection, according to § 98.234(a)(5), to identify the source of the leak. You must use one of the methods specified in paragraphs (o)(4)(ii)(A) through (D) of this section to quantify emissions from the identified source.
- (5) **Methods for continuous measurement from manifolded groups of centrifugal compressor sources.** If you elect to conduct continuous volumetric emission measurements for a manifolded group of compressor sources as specified in paragraph (o)(1)(iv) of this section, you must measure volumetric emissions as specified in paragraphs (o)(5)(i) through (iii) of this section.
- (i) Measure at a single point in the manifold downstream of all compressor inputs and, if practical, prior to comingling with other non-compressor emission sources.
  - (ii) Continuously measure the volumetric flow for the manifolded group of compressor sources at standard conditions using a permanent meter according to methods set forth in § 98.234(b).
  - (iii) If compressor blowdown emissions are included in the metered emissions specified in paragraph (o)(5)(ii) of this section, the compressor blowdown emissions may be included with the reported emissions for the manifolded group of compressor sources and do not need to be calculated separately using the method specified in paragraph (i) of this section for blowdown vent stacks.
- (6) **Method for calculating volumetric GHG emissions from as found measurements for individual centrifugal compressor sources.** For compressor sources measured according to paragraph (o)(1)(i) of this section, you must calculate annual GHG emissions from the compressor sources as specified in paragraphs (o)(6)(i) through (iv) of this section.
- (i) Using equation W-21 to this section, calculate the annual volumetric GHG emissions for each centrifugal compressor mode-source combination specified in paragraphs (o)(1)(i)(A) through (C) of this section that was measured during the reporting year.

$$E_{s,i,m} = MT_{s,m} * T_m * GHG_{i,m} \quad (\text{Eq. W-21})$$

Where:

$E_{s,i,m}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for measured compressor mode-source combination m, at standard conditions, in cubic feet.

$MT_{s,m}$  = Volumetric gas emissions for measured compressor mode-source combination m, in standard cubic feet per hour, measured according to paragraph (o)(2) of this section. If multiple measurements are performed for a given mode-source combination m, use the average of all measurements.

$T_m$  = Total time the compressor is in the mode-source combination for which  $E_{s,i,m}$  is being calculated in the reporting year, in hours.

$GHG_{i,m}$  = Mole fraction of  $GHG_i$  in the vent gas for measured compressor mode-source combination  $m$ ; use the appropriate gas compositions in paragraph (u)(2) of this section.

$m$  = Compressor mode-source combination specified in paragraph (o)(1)(i)(A), (B), or (C) of this section that was measured for the reporting year.

- (ii) Using equation W-22 to this section, calculate the annual volumetric GHG emissions from each centrifugal compressor mode-source combination specified in paragraphs (o)(1)(i)(A) through (C) of this section that was not measured during the reporting year.

$$E_{s,i,m} = EF_{s,m} * T_m * GHG_{i,m} \quad (\text{Eq. W-22})$$

Where:

$E_{s,i,m}$  = Annual volumetric  $GHG_i$  (either  $CH_4$  or  $CO_2$ ) emissions for unmeasured compressor mode-source combination  $m$ , at standard conditions, in cubic feet.

$EF_{s,m}$  = Reporter emission factor for compressor mode-source combination  $m$ , in standard cubic feet per hour, as calculated in paragraph (o)(6)(iii) of this section.

$T_m$  = Total time the compressor was in the unmeasured mode-source combination  $m$ , for which  $E_{s,i,m}$  is being calculated in the reporting year, in hours.

$GHG_{i,m}$  = Mole fraction of  $GHG_i$  in the vent gas for unmeasured compressor mode-source combination  $m$ ; use the appropriate gas compositions in paragraph (u)(2) of this section.

$m$  = Compressor mode-source combination specified in paragraph (o)(1)(i)(A), (B), or (C) of this section that was not measured in the reporting year.

- (iii) Using equation W-23 to this section, develop an emission factor for each compressor mode-source combination specified in paragraphs (o)(1)(i)(A) through (C) of this section. These emission factors must be calculated annually and used in equation W-22 to this section to determine volumetric emissions from a centrifugal compressor in the mode- source combinations that were not measured in the reporting year.

$$EF_{s,m} = \frac{\sum_{p=1}^{Count_m} MT_{s,m,p}}{Count_m} \quad (\text{Eq. W-23})$$

Where:

$EF_{s,m}$  = Reporter emission factor to be used in equation W-22 to this section for compressor mode-source combination  $m$ , in standard cubic feet per hour. The reporter emission factor must be based on all compressors measured in compressor mode-source combination  $m$  in the current reporting year and the preceding two reporting years.

$MT_{s,m,p}$  = Average volumetric gas emission measurement for compressor mode-source combination  $m$ , for compressor  $p$ , in standard cubic feet per hour, calculated using all volumetric gas emission measurements ( $MT_{s,m}$  in equation W-21 to this section) for compressor mode-source combination  $m$  for compressor  $p$  in the current reporting year and the preceding two reporting years.

$Count_m$  = Total number of compressors measured in compressor mode-source combination  $m$  in the current reporting year and the preceding two reporting years.

$m$  = Compressor mode-source combination specified in paragraph (o)(1)(i)(A), (B), or (C) of this section."

- (iv) The reporter emission factor in equation W-23 to this section may be calculated by using all measurements from a single owner or operator instead of only using measurements from a single facility. If you elect to use this option, the reporter emission factor must be applied to all reporting facilities for the owner or operator.

- (7) **Method for calculating volumetric GHG emissions from continuous monitoring of individual centrifugal compressor sources.** For compressor sources measured according to paragraph (o)(1)(ii) of this section, you must use the continuous volumetric emission measurements taken as specified in paragraph (o)(3) of this section and calculate annual volumetric GHG emissions associated with the compressor source using equation W-24A to this section.

$$E_{s,i,v} = Q_{s,v} * GHG_{i,v} \quad (\text{Eq. W-24A})$$

Where:

$E_{s,i,v}$  = Annual volumetric GHG<sub>*i*</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions from compressor source  $v$ , at standard conditions, in cubic feet.

$Q_{s,v}$  = Volumetric gas emissions from compressor source  $v$ , for reporting year, in standard cubic feet.

$GHG_{i,v}$  = Mole fraction of GHG<sub>*i*</sub> in the vent gas for compressor source  $v$ ; use the appropriate gas compositions in paragraph (u)(2) of this section.

- (8) **Method for calculating volumetric GHG emissions from as found measurements of manifolded groups of centrifugal compressor sources.** For manifolded groups of compressor sources measured according to paragraph (o)(1)(iii) of this section, you must calculate annual volumetric GHG emissions using equation W-24B to this section. If the centrifugal compressors included in the manifolded group of compressor sources share the manifold with reciprocating compressors, you must follow the procedures in either this paragraph (o)(8) or paragraph (p)(8) of this section to calculate emissions from the manifolded group of compressor sources.

$$E_{s,i,g} = T_g * MT_{s,g,avg} * GHG_{i,g} \quad (\text{Eq. W-24B})$$

Where:

$E_{s,i,g}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for manifolded group of compressor sources g, at standard conditions, in cubic feet.  $T_g$  = Total time the manifolded group of compressor sources g had potential for emissions in the reporting year, in hours. Include all time during which at least one compressor source in the manifolded group of compressor sources g was in a mode-source combination specified in either paragraph (o)(1)(i)(A), (o)(1)(i)(B), (o)(1)(i)(C), (p)(1)(i)(A), (p)(1)(i)(B), or (p)(1)(i)(C) of this section. Default of 8760 hours may be used.  $MT_{s,g,avg}$  = Average volumetric gas emissions of all measurements performed in the reporting year according to paragraph (o)(4) of this section for the manifolded group of compressor sources g, in standard cubic feet per hour.

GHG<sub>i,g</sub> = Mole fraction of GHG<sub>i</sub> in the vent gas for manifolded group of compressor sources g; use the appropriate gas compositions in paragraph (u)(2) of this section.

- (9) **Method for calculating volumetric GHG emissions from continuous monitoring of manifolded group of centrifugal compressor sources.** For a manifolded group of compressor sources measured according to paragraph (o)(1)(iv) of this section, you must use the continuous volumetric emission measurements taken as specified in paragraph (o)(5) of this section and calculate annual volumetric GHG emissions associated with each manifolded group of compressor sources using equation W-24C to this section. If the centrifugal compressors included in the manifolded group of compressor sources share the manifold with reciprocating compressors, you must follow the procedures in either this paragraph (o)(9) or paragraph (p)(9) of this section to calculate emissions from the manifolded group of compressor sources.

$$E_{s,i,g} = Q_{s,g} * GHG_{i,g} \quad (\text{Eq. W-24C})$$

Where:

$E_{s,i,g}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions from manifolded group of compressor sources g, at standard conditions, in cubic feet.

$Q_{s,g}$  = Volumetric gas emissions from manifolded group of compressor sources g, for reporting year, in standard cubic feet.

GHG<sub>i,g</sub> = Mole fraction of GHG<sub>i</sub> in the vent gas for measured manifolded group of compressor sources g; use the appropriate gas compositions in paragraph (u)(2) of this section.

- (10) **Method for calculating volumetric GHG emissions from wet seal oil degassing vents at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility.** You must calculate volumetric emissions from centrifugal compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility as specified in paragraphs (o)(10)(i) through (iv), as applicable.
- (i) For all centrifugal compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility that are subject to the centrifugal compressor standards in § 60.5380b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter for dry seals and self-contained wet seals, you must conduct the volumetric emission measurements as required by § 60.5380b(a)(5) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, conduct all additional volumetric emission measurements specified

in paragraph (o)(1) of this section using methods specified in paragraphs (o)(2) through (5) of this section (based on the compressor mode (as defined in § 98.238) in which the compressor was found at the time of measurement), and calculate emissions as specified in paragraphs (o)(6) through (9) of this section. Conduct all measurements required by this paragraph (o)(10)(i) at the frequency specified by § 60.5380b(a)(4) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter. For any reporting year in which measuring at the frequency specified by § 60.5380b(a)(4) of this chapter results in measurement not being required for a subject compressor, calculate emissions for all mode-source combinations as specified in paragraph (o)(6)(ii) of this section.

- (ii) For all centrifugal compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility that are not subject to the centrifugal compressor standards in § 60.5380b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter for dry seals and self-contained wet seals, you may elect to conduct the volumetric emission measurements specified in paragraph (o)(1) of this section using methods specified in paragraphs (o)(2) through (5) of this section (based on the compressor mode (as defined in § 98.238) in which the compressor was found at the time of measurement), and calculate emissions as specified in paragraphs (o)(6) through (9) of this section.
- (iii) For all centrifugal compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility for which paragraph (o)(10)(i) of this section does not apply and you do not elect to conduct the volumetric measurements specified in paragraph (o)(1) of this section, you must calculate total atmospheric wet seal oil degassing vent emissions from all centrifugal compressors at either an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility using equation W-25A to this section. Emissions from centrifugal compressor wet seal oil degassing vents that are routed to a flare, combustion, or vapor recovery system are not required to be determined under this paragraph (o).

$$E_{s,i} = \sum_{p=1}^{\text{Count}} E_{s,i,p} \quad (\text{Eq. W-25A})$$

Where:

$E_{s,i}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions from all centrifugal compressors, at standard conditions, in cubic feet.

Count = Total number of centrifugal compressors with wet seal oil degassing vents that are vented directly to the atmosphere.

$E_{s,i,p}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for centrifugal compressor p, at standard conditions, in cubic feet, calculated using equation W-25B to this section.

- (iv) For all centrifugal compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility for which paragraph (o)(10)(i) of this section does not apply, and you do not elect to conduct the volumetric



measurements specified in paragraph (o)(1) of this section, you must calculate wet seal oil degassing vent emissions from each centrifugal compressor using equation W-25B to this section. Emissions from centrifugal compressor wet seal oil degassing vents that are routed to a flare, combustion, or vapor recovery system are not required to be determined under this paragraph (o).

$$E_{s,i,p} = EF_{s,p} \times \frac{T_p}{T_{total}} \times \frac{GHG_{i,p}}{GHG_{EF}} \quad (\text{Eq. W-25B})$$

Where:

$E_{s,i,p}$  = Annual volumetric  $GHG_i$  (either  $CH_4$  or  $CO_2$ ) emissions for centrifugal compressor  $p$ , at standard conditions, in cubic feet.

$EF_{s,p}$  = Emission factor for centrifugal compressor  $p$ , in standard cubic feet per year. Use  $1.2 \times 10^7$  standard cubic feet per year per compressor for  $CH_4$  and  $5.30 \times 10^5$  standard cubic feet per year per compressor for  $CO_2$  at 60 °F and 14.7 psia.

$T_p$  = Total time centrifugal compressor  $p$  was in operating mode, for which  $E_{s,i,p}$  is being calculated in the reporting year, in hours.

$T_{total}$  = Total hours per year. Use 8784 in leap years and use 8760 in all other years.

$GHG_{i,p}$  = Mole fraction of  $GHG$  (either  $CH_4$  or  $CO_2$ ) in the vent gas for centrifugal compressor  $p$  in operating mode; use the appropriate gas compositions in paragraph (u)(2) of this section.

$GHG_{EF}$  = Mole fraction of  $GHG$  (either  $CH_4$  or  $CO_2$ ) used in the determination of  $EF_{s,p}$ . Use 0.95 for  $CH_4$  and 0.05 for  $CO_2$ .

(11) **Method for converting from volumetric to mass emissions.** You must calculate both  $CH_4$  and  $CO_2$  mass emissions from volumetric emissions using calculations in paragraph (v) of this section.

(p) **Reciprocating compressor venting.** If you are required to report emissions from reciprocating compressor venting as specified in § 98.232(d)(1), (e)(1), (f)(1), (g)(1), and (h)(1), you must conduct volumetric emission measurements specified in paragraph (p)(1) of this section using methods specified in paragraphs (p)(2) through (5) of this section; perform calculations specified in paragraphs (p)(6) through (9) of this section; and calculate  $CH_4$  and  $CO_2$  mass emissions as specified in paragraph (p)(11) of this section. If you are required to report emissions from reciprocating compressor venting at an onshore petroleum and natural gas production facility as specified in § 98.232(c)(11) or an onshore petroleum and natural gas gathering and boosting facility as specified in § 98.232(j)(9), you must calculate volumetric emissions as specified in paragraph (p)(10) of this section and calculate  $CH_4$  and  $CO_2$  mass emissions as specified in paragraph (p)(11) of this section. If emissions from a compressor source are routed to a flare, paragraphs (p)(1) through (11) of this section do not apply and instead you must calculate  $CH_4$ ,  $CO_2$ , and  $N_2O$  emissions as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n). If emissions from a compressor source are routed to combustion, paragraphs



(p)(1) through (11) of this section do not apply and instead you must calculate and report emissions as specified in subpart C of this part or paragraph (z) of this section, as applicable. If emissions from a compressor source are routed to a vapor recovery system, paragraphs (p)(1) through (11) of this section do not apply.

- (1) **General requirements for conducting volumetric emission measurements.** You must conduct volumetric emission measurements on each reciprocating compressor as specified in this paragraph. Compressor sources (as defined in § 98.238) without manifolded vents must use a measurement method specified in paragraph (p)(1)(i) or (ii) of this section. Manifolded compressor sources (as defined in § 98.238) must use a measurement method specified in paragraph (p)(1)(i), (ii), (iii), or (iv) of this section.
  - (i) **Reciprocating compressor source as found measurements.** Measure venting from each compressor according to either paragraph (p)(1)(i)(A), (B), or (C) of this section at least once annually, based on the compressor mode (as defined in § 98.238) in which the compressor was found at the time of measurement, except as specified in paragraph (p)(1)(i)(D) of this section. If additional measurements beyond the required annual testing are performed (including duplicate measurements or measurement of additional operating modes), then all measurements satisfying the applicable monitoring and QA/QC that is required by this paragraph (p) must be used in the calculations specified in this section.
    - (A) For a compressor measured in operating-mode, you must measure volumetric emissions from blowdown valve leakage through the blowdown vent as specified in paragraph (p)(2)(i) of this section, and measure volumetric emissions from reciprocating rod packing as specified in paragraph (p)(2)(ii) or (iii) of this section, as applicable.
    - (B) For a compressor measured in not-operating-depressurized-mode, you must measure volumetric emissions from isolation valve leakage as specified in paragraph (p)(2)(i) of this section. If a compressor is not operated and has blind flanges in place throughout the reporting period, measurement is not required in this compressor mode.
    - (C) For a compressor measured in standby-pressurized-mode, you must measure volumetric emissions from blowdown valve leakage through the blowdown vent as specified in paragraph (p)(2)(i) of this section and measure volumetric emissions from reciprocating rod packing as specified in paragraph (p)(2)(ii) or (iii) of this section, as applicable.
    - (D) An annual as found measurement is not required in the first year of operation for any new compressor that begins operation after as found measurements have been conducted for all existing compressors. For only the first year of operation of new compressors, calculate emissions according to paragraph (p)(6)(ii) of this section.
  - (ii) **Reciprocating compressor source continuous monitoring.** Instead of measuring the compressor source according to paragraph (p)(1)(i) of this section for a given compressor, you may elect to continuously measure volumetric emissions from a compressor source as specified in paragraph (p)(3) of this section.
  - (iii) **Manifolded reciprocating compressor source as found measurements.** For a compressor source that is part of a manifolded group of compressor sources (as defined in § 98.238), instead of measuring the compressor source according to paragraph (p)(1)(i), (ii), or (iv) of this section, you may elect to measure combined volumetric emissions from the manifolded group of

compressor sources by conducting measurements at the common vent stack as specified in paragraph (p)(4) of this section. The measurements must be conducted at the frequency specified in paragraphs (p)(1)(iii)(A) and (B) of this section.

- (A) A minimum of one measurement must be taken for each manifolded group of compressor sources in a calendar year.
  - (B) The measurement may be performed while the compressors are in any compressor mode.
  - (iv) **Manifolded reciprocating compressor source continuous monitoring.** For a compressor source that is part of a manifolded group of compressor sources, instead of measuring the compressor source according to paragraph (p)(1)(i), (ii), or (iii) of this section, you may elect to continuously measure combined volumetric emissions from the manifolded group of compressors sources as specified in paragraph (p)(5) of this section.
- (2) **Methods for performing as found measurements from individual reciprocating compressor sources.** If conducting measurements for each compressor source, you must determine the volumetric emissions from blowdown valves and isolation valves as specified in paragraph (p)(2)(i) of this section. You must determine the volumetric emissions from reciprocating rod packing as specified in paragraph (p)(2)(ii) or (iii) of this section, as applicable.
- (i) **For blowdown valves on compressors in operating-mode or standby-pressurized-mode,** and for isolation valves on compressors in not-operating-depressurized-mode, determine the volumetric emissions using one of the methods specified in paragraphs (p)(2)(i)(A) through (D) of this section.
    - (A) Determine the volumetric flow at standard conditions from the blowdown vent using calibrated bagging or high volume sampler according to methods set forth in § 98.234(c) and (d), respectively.
    - (B) Determine the volumetric flow at standard conditions from the blowdown vent using a temporary meter such as a vane anemometer, according to methods set forth in § 98.234(b).
    - (C) Use an acoustic leak detection device according to methods set forth in § 98.234(a)(5).
    - (D) You may choose to use any of the methods set forth in § 98.234(a) to screen for emissions. If emissions are detected using the methods set forth in § 98.234(a), then you must use one of the methods specified in paragraphs (p)(2)(i)(A) through (C) of this section. If emissions are not detected using the methods in § 98.234(a), then you may assume that the volumetric emissions are zero. For the purposes of this paragraph, when using any of the methods in § 98.234(a), emissions are detected whenever a leak is detected according to the method.
  - (ii) **For reciprocating rod packing equipped with an open-ended vent line on compressors in operating-mode or standby-pressurized-mode,** determine the volumetric emissions using one of the methods specified in paragraphs (p)(2)(ii)(A) through (C) of this section.
    - (A) Determine the volumetric flow at standard conditions from the open-ended vent line using calibrated bagging or high volume sampler according to methods set forth in § 98.234(c) and (d), respectively.

- (B) Determine the volumetric flow at standard conditions from the open-ended vent line using a temporary meter such as a vane anemometer, according to methods set forth in § 98.234(b).
    - (C) You may choose to use any of the methods set forth in § 98.234(a)(1) through (3) to screen for emissions. If emissions are detected using one of these specified methods, then you must use one of the methods specified in paragraphs (p)(2)(ii)(A) and (B) of this section. If emissions are not detected using the methods in § 98.234(a)(1) through (3), then you may assume that the volumetric emissions are zero. For the purposes of this paragraph (p)(2)(ii)(C), when using any of the methods in § 98.234(a), emissions are detected whenever a leak is detected according to the method. Acoustic leak detection is only applicable for through-valve leakage and is not applicable for screening or measuring rod packing emissions.
  - (iii) For reciprocating rod packing not equipped with an open-ended vent line on compressors in operating-mode, you must determine the volumetric emissions using the method specified in paragraphs (p)(2)(iii)(A) and (B) of this section.
    - (A) You must use the methods described in § 98.234(a)(1) through (3) to conduct annual leak detection of equipment leaks from the packing case into an open distance piece, or for compressors with a closed distance piece, conduct annual detection of gas emissions from the rod packing vent, distance piece vent, compressor crank case breather cap, or other vent emitting gas from the rod packing. Acoustic leak detection is only applicable for through-valve leakage and is not applicable for screening rod packing emissions.
    - (B) You must measure emissions found in paragraph (p)(2)(iii)(A) of this section using an appropriate meter, calibrated bag, or high volume sampler according to methods set forth in § 98.234(b), (c), and (d), respectively.
- (3) **Methods for continuous measurement from individual reciprocating compressor sources.** If you elect to conduct continuous volumetric emission measurements for an individual compressor source as specified in paragraph (p)(1)(ii) of this section, you must measure volumetric emissions as specified in paragraphs (p)(3)(i) and (p)(3)(ii) of this section.
  - (i) Continuously measure the volumetric flow for the individual compressor sources at standard conditions using a permanent meter according to methods set forth in § 98.234(b).
  - (ii) If compressor blowdown emissions are included in the metered emissions specified in paragraph (p)(3)(i) of this section, the compressor blowdown emissions may be included with the reported emissions for the compressor source and do not need to be calculated separately using the method specified in paragraph (i) of this section for blowdown vent stacks.
- (4) **Methods for performing as found measurements from manifolded groups of reciprocating compressor sources.** If conducting measurements for a manifolded group of compressor sources, you must measure volumetric emissions as specified in paragraphs (p)(4)(i) and (ii) of this section.
  - (i) Measure at a single point in the manifold downstream of all compressor inputs and, if practical, prior to comingling with other non-compressor emission sources.
  - (ii) Determine the volumetric flow at standard conditions from the common stack using one of the methods specified in paragraphs (p)(4)(ii)(A) through (F) of this section.

- (A) A temporary meter such as a vane anemometer according to methods set forth in § 98.234(b).
  - (B) Calibrated bagging according to methods set forth in § 98.234(c).
  - (C) A high volume sampler according to methods set forth in § 98.234(d).
  - (D) [Reserved]
  - (E) You may choose to use any of the methods set forth in § 98.234(a)(1) through (3) to screen for emissions. If emissions are detected using one of these specified methods, then you must use one of the methods specified in paragraphs (p)(4)(ii)(A) through (D) of this section. If emissions are not detected using the methods in § 98.234(a)(1) through (3), then you may assume that the volumetric emissions are zero. For the purposes of this paragraph, when using any of the methods in § 98.234(a), emissions are detected whenever a leak is detected according to the method. Acoustic leak detection is only applicable for through-valve leakage and is not applicable for screening a manifolded group of compressor sources.
  - (F) If one of the screening methods specified in § 98.234(a)(1) through (3) identifies a leak in a manifolded group of reciprocating compressor sources, you may use acoustic leak detection, according to § 98.234(a)(5), to identify the source of the leak. You must use one of the methods specified in paragraphs (p)(4)(ii)(A) through (D) of this section to quantify the emissions from the identified source.
- (5) **Methods for continuous measurement from manifolded groups of reciprocating compressor sources.** If you elect to conduct continuous volumetric emission measurements for a manifolded group of compressor sources as specified in paragraph (p)(1)(iv) of this section, you must measure volumetric emissions as specified in paragraphs (p)(5)(i) through (iii) of this section.
- (i) Measure at a single point in the manifold downstream of all compressor inputs and, if practical, prior to comingling with other non-compressor emission sources.
  - (ii) Continuously measure the volumetric flow for the manifolded group of compressor sources at standard conditions using a permanent meter according to methods set forth in § 98.234(b).
  - (iii) If compressor blowdown emissions are included in the metered emissions specified in paragraph (p)(5)(ii) of this section, the compressor blowdown emissions may be included with the reported emissions for the manifolded group of compressor sources and do not need to be calculated separately using the method specified in paragraph (i) of this section for blowdown vent stacks.
- (6) **Method for calculating volumetric GHG emissions from as found measurements for individual reciprocating compressor sources.** For compressor sources measured according to paragraph (p)(1)(i) of this section, you must calculate GHG emissions from the compressor sources as specified in paragraphs (p)(6)(i) through (iv) of this section.
- (i) Using equation W-26 to this section, calculate the annual volumetric GHG emissions for each reciprocating compressor mode-source combination specified in paragraphs (p)(1)(i)(A) through (C) of this section that was measured during the reporting year.

$$E_{s,i,m} = MT_{s,m} * T_m * GHG_{i,m}$$

(Eq. W-26)

Where:

$E_{s,i,m}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for measured compressor mode-source combination m, at standard conditions, in cubic feet.

$MT_{s,m}$  = Volumetric gas emissions for measured compressor mode-source combination m, in standard cubic feet per hour, measured according to paragraph (p)(2) of this section. If multiple measurements are performed for a given mode-source combination m, use the average of all measurements.

$T_m$  = Total time the compressor is in the mode-source combination m, for which  $E_{s,i,m}$  is being calculated in the reporting year, in hours.

GHG<sub>i,m</sub> = Mole fraction of GHG<sub>i</sub> in the vent gas for measured compressor mode-source combination m; use the appropriate gas compositions in paragraph (u)(2) of this section.

m = Compressor mode-source combination specified in paragraph (p)(1)(i)(A), (B), or (C) of this section that was measured for the reporting year.

- (ii) Using equation W-27 to this section, calculate the annual volumetric GHG emissions from each reciprocating compressor mode-source combination specified in paragraphs (p)(1)(i)(A) through (C) of this section that was not measured during the reporting year.

$$E_{s,i,m} = EF_{s,m} * T_m * GHG_{i,m} \quad (\text{Eq. W-27})$$

Where:

$E_{s,i,m}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for unmeasured compressor mode-source combination m, at standard conditions, in cubic feet.

$EF_{s,m}$  = Reporter emission factor for compressor mode-source combination m, in standard cubic feet per hour, as calculated in paragraph (p)(6)(iii) of this section.

$T_m$  = Total time the compressor was in the unmeasured mode-source combination m, for which  $E_{s,i,m}$  is being calculated in the reporting year, in hours.

GHG<sub>i,m</sub> = Mole fraction of GHG<sub>i</sub> in the vent gas for unmeasured compressor mode-source combination m; use the appropriate gas compositions in paragraph (u)(2) of this section.

m = Compressor mode-source combination specified in paragraph (p)(1)(i)(A), (p)(1)(i)(B), or (p)(1)(i)(C) of this section that was not measured for the reporting year.

- (iii) Using equation W-28 to this section, develop an emission factor for each compressor mode-source combination specified in paragraphs (p)(1)(i)(A) through (C) of this section. These emission factors must be calculated annually and used in equation W-27 to this section to determine volumetric emissions from a reciprocating compressor in the mode-source combinations that were not measured in the reporting year.

$$EF_{s,m} = \frac{\sum_{p=1}^{Count_m} MT_{s,m,p}}{Count_m} \quad (\text{Eq. W-28})$$

Where:

$EF_{s,m}$  = Reporter emission factor to be used in equation W-27 to this section for compressor mode-source combination  $m$ , in standard cubic feet per hour. The reporter emission factor must be based on all compressors measured in compressor mode-source combination  $m$  in the current reporting year and the preceding two reporting years.

$MT_{s,m,p}$  = Average volumetric gas emission measurement for compressor mode-source combination  $m$ , for compressor  $p$ , in standard cubic feet per hour, calculated using all volumetric gas emission measurements ( $MT_{s,m}$  in equation W-26 to this section) for compressor mode-source combination  $m$  for compressor  $p$  in the current reporting year and the preceding two reporting years.

$Count_m$  = Total number of compressors measured in compressor mode-source combination  $m$  in the current reporting year and the preceding two reporting years.

$m$  = Compressor mode-source combination specified in paragraph (p)(1)(i)(A), (B), or (C) of this section.

- (iv) The reporter emission factor in equation W-28 to this section may be calculated by using all measurements from a single owner or operator instead of only using measurements from a single facility. If you elect to use this option, the reporter emission factor must be applied to all reporting facilities for the owner or operator.

- (7) **Method for calculating volumetric GHG emissions from continuous monitoring of individual reciprocating compressor sources.** For compressor sources measured according to paragraph (p)(1)(ii) of this section, you must use the continuous volumetric emission measurements taken as specified in paragraph (p)(3) of this section and calculate annual volumetric GHG emissions associated with the compressor source using equation W-29A to this section.

$$E_{s,i,v} = Q_{s,v} * GHG_{i,v} \quad (\text{Eq. W-29A})$$

Where:

$E_{s,i,v}$  = Annual volumetric  $GHG_i$  (either  $CH_4$  or  $CO_2$ ) emissions from compressor source  $v$ , at standard conditions, in cubic feet.

$Q_{s,v}$  = Volumetric gas emissions from compressor source  $v$ , for reporting year, in standard cubic feet.

$GHG_{i,v}$  = Mole fraction of  $GHG_i$  in the vent gas for compressor source  $v$ ; use the appropriate gas compositions in paragraph (u)(2) of this section.

- (8) **Method for calculating volumetric GHG emissions from as found measurements of manifolded groups of reciprocating compressor sources.** For manifolded groups of compressor sources measured according to paragraph (p)(1)(iii) of this section, you must calculate annual GHG emissions using equation W-29B to this section. If the reciprocating compressors included in the manifolded group of compressor sources share the manifold with centrifugal compressors, you must follow the procedures in either this paragraph (p)(8) or paragraph (o)(8) of this section to calculate emissions from the manifolded group of compressor sources.

$$E_{s,i,g} = T_g * MT_{s,g,avg} * GHG_{i,g} \quad (\text{Eq. W-29B})$$

Where:

$E_{s,i,g}$  = Annual volumetric  $GHG_i$  (either  $CH_4$  or  $CO_2$ ) emissions for manifolded group of compressor sources  $g$ , at standard conditions, in cubic feet.

$T_g$  = Total time the manifolded group of compressor sources  $g$  had potential for emissions in the reporting year, in hours. Include all time during which at least one compressor source in the manifolded group of compressor sources  $g$  was in a mode-source combination specified in either paragraph (o)(1)(i)(A), (o)(1)(i)(B), (o)(1)(i)(C), (p)(1)(i)(A), (p)(1)(i)(B), or (p)(1)(i)(C) of this section. Default of 8760 hours may be used.

$MT_{s,g,avg}$  = Average volumetric gas emissions of all measurements performed in the reporting year according to paragraph (p)(4) of this section for the manifolded group of compressor sources  $g$ , in standard cubic feet per hour.

$GHG_{i,g}$  = Mole fraction of  $GHG_i$  in the vent gas for manifolded group of compressor sources  $g$ ; use the appropriate gas compositions in paragraph (u)(2) of this section.

- (9) **Method for calculating volumetric GHG emissions from continuous monitoring of manifolded group of reciprocating compressor sources.** For a manifolded group of compressor sources measured according to paragraph (p)(1)(iv) of this section, you must use the continuous volumetric emission measurements taken as specified in paragraph (p)(5) of this section and calculate annual volumetric GHG emissions associated with each manifolded group of compressor sources using equation W-29C to this section. If the reciprocating compressors included in the manifolded group of compressor sources share the manifold with centrifugal compressors, you must follow the procedures in either this paragraph (p)(9) or paragraph (o)(9) of this section to calculate emissions from the manifolded group of compressor sources.

$$E_{s,i,g} = Q_{s,g} * GHG_{i,g} \quad (\text{Eq. W-29C})$$

Where:

$E_{s,i,g}$  = Annual volumetric  $GHG_i$  (either  $CH_4$  or  $CO_2$ ) emissions from manifolded group of compressor sources  $g$ , at standard conditions, in cubic feet.

$Q_{s,g}$  = Volumetric gas emissions from manifolded group of compressor sources  $g$ , for reporting year, in standard cubic feet.

$GHG_{i,g}$  = Mole fraction of  $GHG_i$  in the vent gas for measured manifolded group of compressor sources  $g$ ; use the appropriate gas compositions in paragraph (u)(2) of this section.

- (10) **Method for calculating volumetric GHG emissions from reciprocating compressor venting at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility.** You must calculate volumetric emissions from reciprocating compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility as specified in paragraphs (p)(10)(i) through (iv) of this section, as applicable.
- (i) For all reciprocating compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility that are subject to the reciprocating compressor standards in § 60.5385b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you must conduct the volumetric emission measurements as required by § 60.5385b(b) and (c) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, conduct any additional volumetric emission measurements specified in paragraph (p)(1) of this section using methods specified in paragraphs (p)(2) through (5) of this section (based on the compressor mode (as defined in § 98.238) in which the compressor was found at the time of measurement), and calculate emissions as specified in paragraphs (p)(6) through (9) of this section. Conduct all measurements required by this paragraph (p)(10)(i) at the frequency specified by § 60.5385b(a) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter. For any reporting year in which measuring at the frequency specified by § 60.5385b(a) of this chapter results in measurement not being required for a subject compressor, calculate emissions for all mode-source combinations as specified in paragraph (p)(6)(ii) of this section.
  - (ii) For all reciprocating compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility that are not subject to the reciprocating compressor standards in § 60.5385b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you may elect to conduct volumetric emission measurements specified in paragraph (p)(1) of this section using methods specified in paragraphs (p)(2) through (5) of this section (based on the compressor mode (as defined in § 98.238) in which the compressor was found at the time of measurement), and calculate emissions as specified in paragraphs (p)(6) through (9) of this section.
  - (iii) For all reciprocating compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility for which paragraph (p)(10)(i) of this section does not apply, and you do not elect to conduct volumetric emission measurements specified in paragraph (p)(1) of this section, you must calculate total atmospheric rod packing emissions from all reciprocating compressors at either an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility using equation W-29D to this section. Reciprocating compressor rod packing emissions that are routed to a flare, combustion, or vapor recovery system are not required to be determined under this paragraph (p).



$$E_{s,i} = \sum_{p=1}^{Count} E_{s,i,p} \quad (\text{Eq. W-29D})$$

Where:

$E_{s,i}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions from all reciprocating compressors, at standard conditions, in cubic feet.

Count = Total number of reciprocating compressors with rod packing emissions vented directly to the atmosphere.

$E_{s,i,p}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for reciprocating compressor p, at standard conditions, in cubic feet, calculated using equation W-29E to this section.

- (iv) For all reciprocating compressors at an onshore petroleum and natural gas production facility or an onshore petroleum and natural gas gathering and boosting facility for which paragraph (p)(10)(i) of this section does not apply, you must calculate rod packing vent emissions from each reciprocating compressor using equation W-29E to this section. Reciprocating compressor rod packing emissions that are routed to a flare, combustion, or vapor recovery system are not required to be determined under this paragraph (p).

$$E_{s,i,p} = EF_{s,p} \times \frac{T_p}{T_{total}} \times \frac{GHG_{i,p}}{GHG_{EF}} \quad (\text{Eq. W-29E})$$

Where:

$E_{s,i,p}$  = Annual volumetric GHG<sub>i</sub> (either CH<sub>4</sub> or CO<sub>2</sub>) emissions for reciprocating compressor p, at standard conditions, in cubic feet.

$EF_{s,p}$  = Emission factor for reciprocating compressor p, in standard cubic feet per year. Use  $2.13 \times 10^5$  standard cubic feet per year per compressor for CH<sub>4</sub> and  $1.18 \times 10^4$  standard cubic feet per year per compressor for CO<sub>2</sub> at 60 °F and 14.7 psia.

$T_p$  = Total time reciprocating compressor p was in operating mode, for which  $E_{s,i,p}$  is being calculated in the reporting year, in hours.

$T_{total}$  = Total hours per year. Use 8784 in leap years and use 8760 in all other years.

$GHG_{i,p}$  = Mole fraction of GHG (either CH<sub>4</sub> or CO<sub>2</sub>) in the vent gas for reciprocating compressor p in operating mode; use the appropriate gas compositions in paragraph (u)(2) of this section.

$GHG_{EF}$  = Mole fraction of GHG (either CH<sub>4</sub> or CO<sub>2</sub>) used in the determination of  $EF_{s,p}$ . Use 0.98 for CH<sub>4</sub> and 0.02 for CO<sub>2</sub>.

(11) **Method for converting from volumetric to mass emissions.** You must calculate both CH<sub>4</sub> and CO<sub>2</sub> mass emissions from volumetric emissions using calculations in paragraph (v) of this section.

(q) **Equipment leak surveys.** For the components identified in paragraphs (q)(1)(i) through (iii) and (v) of this section, you must conduct equipment leak surveys using the leak detection methods specified in paragraphs (q)(1)(i) through (iii) and (v) of this section. For the components identified in paragraph (q)(1)(iv) and (vi) of this section, you may elect to conduct equipment leak surveys, and if you elect to conduct surveys, you must use a leak detection method specified in paragraph (q)(1)(iv) and (vi) of this section. This paragraph (q) applies to components in streams with gas content greater than 10 percent CH<sub>4</sub> plus CO<sub>2</sub> by weight. Components in streams with gas content less than or equal to 10 percent CH<sub>4</sub> plus CO<sub>2</sub> by weight are exempt from the requirements of this paragraph (q) and do not need to be reported. Tubing systems equal to or less than one half inch diameter are exempt from the requirements of this paragraph (q) and do not need to be reported. Equipment leak components in vacuum service are exempt from the survey and emission estimation requirements of this paragraph (q) and only the count of these equipment must be reported.

(1) **Survey requirements –**

- (i) For the components listed in § 98.232(e)(7), (f)(5), (g)(4), and (h)(5), that are not subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you must conduct surveys using any of the leak detection methods listed in § 98.234(a) and calculate equipment leak emissions using the procedures specified in either paragraph (q)(2) or (3) of this section.
- (ii) For the components listed in § 98.232(i)(1), you must conduct surveys using any of the leak detection methods listed in § 98.234(a) except § 98.234(a)(2)(ii) and calculate equipment leak emissions using the procedures specified in either paragraph (q)(2) or (3) of this section.
- (iii) For the components listed in § 98.232(c)(21)(i), (e)(7) and (8), (f)(5) through (8), (g)(4), (g)(6) and (7), (h)(5), (h)(7) and (8), and (j)(10)(i) that are subject to the well site or compressor station fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, and are required to conduct surveys using any of the leak detection methods in § 98.234(a)(1)(ii) or (iii) or (a)(2)(ii), as applicable, you must use the results of those surveys to calculate equipment leak emissions using the procedures specified in either paragraph (q)(2) or (3) of this section.
- (iv) For the components listed in § 98.232(c)(21)(i), (e)(8), (f)(6) through (8), (g)(6) or (7), (h)(7) or (8), or (j)(10)(i), that are not subject to or are not required to conduct surveys using the methods in § 98.234(a) in accordance with the fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you may elect to conduct surveys according to this paragraph (q), and, if you elect to do so, then you must use one of the leak detection methods in § 98.234(a).

- (A) If you elect to use a leak detection method in § 98.234(a) for the surveyed component types in § 98.232(c)(21)(i), (f)(7), (g)(6), (h)(7), or (j)(10)(i) in lieu of the population count methodology specified in paragraph (r) of this section, then you must calculate emissions for the surveyed component types in § 98.232(c)(21)(i), (f)(7), (g)(6), (h)(7), or (j)(10)(i) using the procedures in either paragraph (q)(2) or (3) of this section.
- (B) If you elect to use a leak detection method in § 98.234(a) for the surveyed component types in § 98.232(e)(8), (f)(6) and (8), (g)(7), and (h)(8), then you must use the procedures in either paragraph (q)(2) or (3) of this section to calculate those emissions.
- (C) If you elect to use a leak detection method in § 98.234(a)(1)(ii) or (iii) or (a)(2)(ii), as applicable, for any elective survey under paragraph (q)(1)(iv) of this section, then you must survey the component types in § 98.232(c)(21)(i), (e)(8), (f)(6) through (8), (g)(6) and (7), (h)(7) and (8), and (j)(10)(i) that are not subject to or are not required to conduct surveys using the methods in § 98.234(a) in accordance with the fugitive emissions standards in § 60.5397a of this chapter, the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b or 60.5398b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, and you must calculate emissions from the surveyed component types in § 98.232(c)(21)(i), (e)(8), (f)(6) through (8), (g)(6) and (7), (h)(7) and (8), and (j)(10)(i) using the emission calculation requirements in either paragraph (q)(2) or (3) of this section.
- (v) For the components listed in § 98.232(d)(7), you must conduct surveys as specified in paragraphs (q)(1)(v)(A) and (B) of this section and you must calculate equipment leak emissions using the procedures specified in either paragraph (q)(2) or (3) of this section.
  - (A) For the components listed in § 98.232(d)(7) that are not subject to the equipment leak standards for onshore natural gas processing plants in § 60.5400b or § 60.5401b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you may use any of the leak detection methods listed in § 98.234(a).
  - (B) For the components listed in § 98.232(d)(7) that are subject to the equipment leak standards for onshore natural gas processing plants in § 60.5400b or § 60.5401b of this chapter, or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you must use either of the leak detection methods in § 98.234(a)(1)(iii) or (a)(2)(ii).
- (vi) For the components listed in § 98.232(m)(3)(ii) and (m)(4)(ii), you may elect to conduct surveys according to this paragraph (q), and, if you elect to do so, then you must use one of the leak detection methods in § 98.234(a). If you elect to use a leak detection method in § 98.234(a) for the surveyed component types in § 98.232(m)(3)(ii) and (m)(4)(ii) in lieu of the population count methodology specified in paragraph (r) of this section, then you must calculate emissions for the surveyed component types in § 98.232(m)(3)(ii) and (m)(4)(ii) using the procedures in either paragraph (q)(2) or (3) of this section.
- (vii) Except as provided in paragraph (q)(1)(viii) of this section, you must conduct at least one complete leak detection survey in a calendar year. If you conduct multiple complete leak detection surveys in a calendar year, you must use the results from each complete leak detection survey when calculating emissions using the procedures specified in either paragraph

(q)(2) or (3) of this section. Except as provided in paragraphs (q)(1)(vii)(A) through (H) of this section, a complete leak detection survey is a survey in which all equipment components required to be surveyed as specified in paragraphs (q)(1)(i) through (vi) of this section are surveyed.

- (A) For components subject to the well site and compressor station fugitive emissions standards in § 60.5397a of this chapter, each survey conducted in accordance with § 60.5397a of this chapter using one of the methods in § 98.234(a) will be considered a complete leak detection survey for purposes of this section.
- (B) For components subject to the well site, centralized production facility, and compressor station fugitive emissions standards in § 60.5397b or 60.5398b of this chapter, each survey conducted in accordance with the fugitive emissions standards for well sites, centralized production facilities, and compressor stations in § 60.5397b, 60.5398b(b)(4) or 60.5398b(b)(5)(ii) of this chapter using one of the methods in § 98.234(a) will be considered a complete leak detection survey for purposes of this section.
- (C) For components subject to the well site, centralized production facility, and compressor station fugitive emissions standards in an applicable approved state plan or applicable Federal plan in part 62 of this chapter, each survey conducted in accordance with the applicable approved state plan or applicable Federal plan in part 62 of this chapter using one of the methods in § 98.234(a) will be considered a complete leak detection survey for purposes of this section.
- (D) For an onshore petroleum and natural gas production facility electing to conduct leak detection surveys according to paragraph (q)(1)(iv) of this section, a survey of all required components at a single well-pad site, as defined in § 98.238, will be considered a complete leak detection survey for purposes of this section.
- (E) For an onshore petroleum and natural gas gathering and boosting facility electing to conduct leak detection surveys according to paragraph (q)(1)(iv) of this section, a survey of all required components at a gathering and boosting site, as defined in § 98.238, will be considered a complete leak detection survey for purposes of this section.
- (F) For an onshore natural gas processing facility subject to the equipment leak standards for onshore natural gas processing plants in § 60.5400b or § 60.5401b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, each survey conducted in accordance with the equipment leak standards for onshore natural gas processing plants in § 60.5400b or § 60.5401b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter will be considered a complete leak detection survey for the purposes of calculating emissions using the procedures specified in either paragraph (q)(2) or (3) of this section. At least one complete leak detection survey conducted during the reporting year must include all components listed in § 98.232(d)(7) and subject to this paragraph (q), including components which are considered difficult-to-monitor emission sources as specified in § 98.234(a). Inaccessible components as provided in §§ 60.5401b(h)(3) and 60.5401c(h)(3) of this chapter are exempt from the monitoring requirements in this subpart.

- (G) For natural gas distribution facilities that choose to conduct equipment leak surveys at all above grade transmission-distribution transfer stations over multiple years as provided in paragraph (q)(1)(viii) of this section, a survey of all required components at the above grade transmission-distribution transfer stations monitored during the calendar year will be considered a complete leak detection survey for purposes of this section.
- (H) For onshore natural gas transmission pipeline facilities that conduct leak detection surveys according to paragraph (q)(1)(vi) of this section, a survey of all required components at a transmission company interconnect metering-regulating station or a farm tap/direct sale metering-regulating station, will be considered a complete leak detection survey for purposes of this section.
- (viii) Natural gas distribution facilities are required to perform equipment leak surveys only at above grade stations that qualify as transmission-distribution transfer stations. Below grade transmission-distribution transfer stations and all metering-regulating stations that do not meet the definition of transmission-distribution transfer stations are not required to perform equipment leak surveys under this section. Natural gas distribution facilities may choose to conduct equipment leak surveys at all above grade transmission-distribution transfer stations over multiple years “n,” not exceeding a five-year period to cover all above grade transmission-distribution transfer stations. If the facility chooses to use the multiple year option, then the number of transmission-distribution transfer stations that are monitored in each year should be approximately equal across all years in the cycle.
- (2) **Calculation Method 1: Leaker emission factor calculation methodology.** If you elect not to measure leaks according to Calculation Method 2 as specified in paragraph (q)(3) of this section, you must use this Calculation Method 1 for all components included in a complete leak survey. For industry segments listed in § 98.230(a)(2) through (10), if equipment leaks are detected during surveys required or elected for components listed in paragraphs (q)(1)(i) through (vi) of this section, then you must calculate equipment leak emissions per component type per reporting facility, well-pad site, or gathering and boosting site, as applicable, using equation W-30 to this section and the requirements specified in paragraphs (q)(2)(i) through (x) and (xii) of this section. For the industry segment listed in § 98.230(a)(8), the results from equation W-30 to this section are used to calculate population emission factors on a meter/regulator run basis using equation W-31 to this section. If you chose to conduct equipment leak surveys at all above grade transmission-distribution transfer stations over multiple years, “n,” according to paragraph (q)(1)(viii) of this section, then you must calculate the emissions from all above grade transmission-distribution transfer stations as specified in paragraph (q)(2)(xi) of this section.

$$E_{s,p,i} = GHG_i \times EF_{sp} \times \sum_{z=1}^{x_p} T_{p,z} \times k \quad (\text{Eq. W-30})$$

Where:

$E_{s,p,i}$  = Annual total volumetric emissions of  $GHG_i$  from specific component type “p” (in accordance with paragraphs (q)(1)(i) through (vi) of this section) in standard (“s”) cubic feet, as specified in paragraphs (q)(2)(ii) through (x) and (xii) of this section.

$x_p$  = Total number of specific component type “p” detected as leaking in any leak survey during the year. A component found leaking in two or more surveys during the year is counted as one leaking component.

$EF_{s,p}$  = Leaker emission factor as specified in paragraphs (q)(2)(iii) through (x) and (xii) of this section.

k = Factor to adjust for undetected leaks by respective leak detection method, where k equals 1.25 for the methods in § 98.234(a)(1), (3) and (5); k equals 1.55 for the method in § 98.234(a)(2)(i); and k equals 1.27 for the method in § 98.234(a)(2)(ii).

$GHG_i$  = For onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities, concentration of  $GHG_i$ ,  $CH_4$  or  $CO_2$ , in produced natural gas as defined in paragraph (u)(2) of this section; for onshore natural gas processing facilities, concentration of  $GHG_i$ ,  $CH_4$  or  $CO_2$ , in the total hydrocarbon of the feed natural gas; for onshore natural gas transmission compression and underground natural gas storage,  $GHG_i$  equals 0.975 for  $CH_4$  and  $1.1 \times 10^{-2}$  for  $CO_2$  or concentration of  $GHG_i$ ,  $CH_4$  or  $CO_2$ , in the total hydrocarbon of the feed natural gas; for LNG storage and LNG import and export equipment,  $GHG_i$  equals 1 for  $CH_4$  and 0 for  $CO_2$ ; and for natural gas distribution and onshore natural gas transmission pipeline,  $GHG_i$  equals 1 for  $CH_4$  and  $1.1 \times 10^{-2}$  for  $CO_2$ .

$T_{p,z}$  = The total time the surveyed component “z,” component type “p,” was assumed to be leaking and operational, in hours. If one leak detection survey is conducted in the calendar year, assume the component was leaking for the entire calendar year. If multiple leak detection surveys are conducted in the calendar year, assume a component found leaking in the first survey was leaking since the beginning of the year until the date of the survey; assume a component found leaking in the last survey of the year was leaking from the preceding survey through the end of the year; assume a component found leaking in a survey between the first and last surveys of the year was leaking since the preceding survey until the date of the survey; and sum times for all leaking periods. For each leaking component, account for time the component was not operational (*i.e.*, not operating under pressure) using an engineering estimate based on best available data.

- (i) The leak detection surveys selected for use in equation W-30 to this section must be conducted during the calendar year as indicated in paragraph (q)(1)(vii) and (viii) of this section, as applicable.
- (ii) Calculate both  $CO_2$  and  $CH_4$  mass emissions using calculations in paragraph (v) of this section.
- (iii) Onshore petroleum and natural gas production facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default whole gas leaker emission factors consistent with the well type, where components associated with gas wells are considered to be in gas service and components associated with oil wells are considered to be in oil service as listed in table W-2 to this subpart.
- (iv) Onshore petroleum and natural gas gathering and boosting facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default whole gas leaker factors for components in gas service listed in table W-2 to this subpart.
- (v) Onshore natural gas processing facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default total hydrocarbon leaker emission factors for compressor components in gas service and non-compressor components in gas service listed in table W-4 to this subpart.

- (vi) Onshore natural gas transmission compression facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default total hydrocarbon leaker emission factors for compressor components in gas service and non-compressor components in gas service listed in table W-4 to this subpart.
- (vii) Underground natural gas storage facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default total hydrocarbon leaker emission factors for storage stations or storage wellheads in gas service listed in table W-4 to this subpart.
- (viii) LNG storage facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default methane leaker emission factors for LNG storage components in LNG service or gas service listed in table W-6 to this subpart.
- (ix) LNG import and export facilities must, if available, use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of section or use the appropriate default methane leaker emission factors for LNG terminals components in LNG service or gas service listed in table W-6 to this subpart.
- (x) Except as provided in paragraph (q)(3)(viii) of this section, natural gas distribution facilities must use equation W-30 to this section and the default methane leaker emission factors for transmission-distribution transfer station components in gas service listed in table W-6 to this subpart to calculate component emissions from annual equipment leak surveys conducted at above grade transmission-distribution transfer stations.
  - (A) Use equation W-31 to this section to determine the meter/regulator run population emission factors for each GHG<sub>i</sub>. As additional survey data become available, you must recalculate the meter/regulator run population emission factors for each GHG<sub>i</sub> annually according to paragraph (q)(2)(x)(B) of this section.

$$EF_{s,MR,i} = \frac{\sum_{y=1}^n \sum_{p=1}^7 E_{s,p,i,y}}{\sum_{y=1}^n \sum_{w=1}^{Count_{MR,y}} T_{w,y}} \quad (\text{Eq. W-31})$$

Where:

$EF_{s,MR,i}$  = Meter/regulator run population emission factor for GHG<sub>i</sub> based on all surveyed above grade transmission-distribution transfer stations over “n” years, in standard cubic feet of GHG<sub>i</sub> per operational hour of all meter/regulator runs.

$E_{s,p,i,y}$  = Annual total volumetric emissions at standard conditions of GHG<sub>i</sub> from component type “p” during year “y” in standard (“s”) cubic feet, as calculated using equation W-30 to this section.

p = Seven component types listed in table W-6 to this subpart for transmission-distribution transfer stations.



$T_{w,y}$  = The total time the surveyed meter/regulator run “w” was operational, in hours during survey year “y” using an engineering estimate based on best available data.

$\text{Count}_{MR,y}$  = Count of meter/regulator runs surveyed at above grade transmission-distribution transfer stations in year “y”.

y = Year of data included in emission factor “ $EF_{s,MR,i}$ ” according to paragraph (q)(2)(x)(B) of this section.

n = Number of years of data, according to paragraph (q)(1)(viii) of this section, whose results are used to calculate emission factor “ $EF_{s,MR,i}$ ” according to paragraph (q)(2)(x)(B) of this section.

(B) The emission factor “ $EF_{s,MR,i}$ ” based on annual equipment leak surveys at above grade transmission-distribution transfer stations, must be calculated annually. If you chose to conduct equipment leak surveys at all above grade transmission-distribution transfer stations over multiple years, “n,” according to paragraph (q)(1)(viii) of this section and you have submitted a smaller number of annual reports than the duration of the selected cycle period of 5 years or less, then all available data from the current year and previous years must be used in the calculation of the emission factor “ $EF_{s,MR,i}$ ” from equation W-31 to this section. After the first survey cycle of “n” years is completed and beginning in calendar year (n+1), the survey will continue on a rolling basis by including the survey results from the current calendar year “y” and survey results from all previous (n-1) calendar years, such that each annual calculation of the emission factor “ $EF_{s,MR,i}$ ” from equation W-31 to this section is based on survey results from “n” years. Upon completion of a cycle, you may elect to change the number of years in the next cycle period (to be 5 years or less). If the number of years in the new cycle is greater than the number of years in the previous cycle, calculate “ $EF_{s,MR,i}$ ” from equation W-31 to this section in each year of the new cycle using the survey results from the current calendar year and the survey results from the preceding number years that is equal to the number of years in the previous cycle period. If the number of years, “ $n_{new}$ ,” in the new cycle is smaller than the number of years in the previous cycle, “n,” calculate “ $EF_{s,MR,i}$ ” from equation W-31 to this section in each year of the new cycle using the survey results from the current calendar year and survey results from all previous ( $n_{new}-1$ ) calendar years.

(xi) If you chose to conduct equipment leak surveys at all above grade transmission-distribution transfer stations over multiple years, “n,” according to paragraph (q)(1)(viii) of this section, you must use the meter/regulator run population emission factors calculated using equation W-31 to this section and the total count of all meter/regulator runs at above grade transmission-distribution transfer stations to calculate emissions from all above grade transmission-distribution transfer stations using equation W-32B to this section.

(xii) Onshore natural gas transmission pipeline facilities must use the facility-specific leaker emission factor calculated in accordance with paragraph (q)(4) of this section.

(3) **Calculation Method 2: Leaker measurement methodology.** For industry segments listed in § 98.230(a)(2) through (10), if equipment leaks are detected during surveys required or elected for components listed in paragraphs (q)(1)(i) through (vi) of this section, you may elect to measure the volumetric flow rate of each natural gas leak identified during a complete leak survey. If you elect to use this method, you must use this method for all components included in a complete leak survey



and you must determine the volumetric flow rate of each natural gas leak identified during the leak survey and aggregate the emissions by the method of leak detection and component type as specified in paragraphs (q)(3)(i) through (vii) of this section.

- (i) Determine the volumetric flow rate of each natural gas leak identified during the leak survey following the methods § 98.234(b) through (d), as appropriate for each leak identified. You do not need to use the same measurement method for each leak measured. If you are unable to measure the natural gas leak because it would require elevating the measurement personnel more than 2 meters above the surface and a lift is unavailable at the site or it would pose immediate danger to measurement personnel, then you must substitute the default leak rate for the component and site type from tables W-2, W-4, or W-6 to this subpart, as applicable, as the measurement for this leak.
- (ii) For each leak, calculate the volume of natural gas emitted as the product of the natural gas flow rate measured in paragraph (q)(3)(i) of this section and the duration of the leak. If one leak detection survey is conducted in the calendar year, assume the component was leaking for the entire calendar year. If multiple leak detection surveys are conducted in the calendar year, assume a component found leaking in the first survey was leaking since the beginning of the year until the date of the survey; assume a component found leaking in the last survey of the year was leaking from the preceding survey through the end of the year; assume a component found leaking in a survey between the first and last surveys of the year was leaking since the preceding survey until the date of the survey. For each leaking component, account for time the component was not operational (*i.e.*, not operating under pressure) using an engineering estimate based on best available data.
- (iii) For each leak, convert the volumetric emissions of natural gas determined in paragraph (q)(3)(ii) of this section to standard conditions using the method specified in paragraph (t)(1) of this section.
- (iv) For each leak, convert the volumetric emissions of natural gas at standard conditions determined in paragraph (q)(3)(iii) of this section to CO<sub>2</sub> and CH<sub>4</sub> volumetric emissions at standard conditions using the methods specified in paragraph (u) of this section.
- (v) For each leak, convert the GHG volumetric emissions at standard conditions determined in paragraph (q)(3)(iv) of this section to GHG mass emissions using the methods specified in paragraph (v) of this section.
- (vi) Sum the CO<sub>2</sub> and CH<sub>4</sub> mass emissions determined in paragraph (q)(3)(v) of this section separately for each type of component required to be surveyed by the method used for the survey for which a leak was detected.
- (vii) Multiply the total CO<sub>2</sub> and CH<sub>4</sub> mass emissions by survey method and component type determined in paragraph (q)(3)(vi) of this section by the survey specific value for “k”, the factor adjustment for undetected leaks, where k equals 1.25 for the methods in § 98.234(a)(1), (3) and (5); k equals 1.55 for the method in § 98.234(a)(2)(i); and k equals 1.27 for the method in § 98.234(a)(2)(ii).
- (viii) For natural gas distribution facilities:
  - (A) Use equation W-31 to this section to determine the meter/regulator run population emission factors for each GHG; using the methods as specified in paragraphs (q)(2)(x)(A) and (B) of this section, except use the sum of the GHG volumetric emissions for each type

of component required to be surveyed by the method used for the survey for which a leak was detected calculated in paragraph (q)(3)(iv) of this section rather than the emissions calculated using equation W-30 to this section.

- (B) If you chose to conduct equipment leak surveys at all above grade transmission-distribution transfer stations over multiple years, “n,” according to paragraph (q)(1)(viii) of this section, you must use the meter/regulator run population emission factors calculated according to paragraph (q)(3)(viii)(A) of this section and the total count of all meter/regulator runs at above grade transmission-distribution transfer stations to calculate emissions from all above grade transmission-distribution transfer stations using equation W-32B to this section.

(4) ***Development of facility-specific component-level leaker emission factors by leak detection method.*** If you elect to measure leaks according to Calculation Method 2 as specified in paragraph (q)(3) of this section, you must use the measurement values determined in accordance with paragraph (q)(3) of this section to calculate a facility-specific component-level leaker emission factor by leak detection method as provided in paragraphs (q)(4)(i) through (iv) of this section.

- (i) You must track the leak measurements made separately for each of the applicable components listed in paragraphs (q)(1)(i) through (vi) of this section and by the leak detection method according to the following three bins.

- (A) Method 21 as specified in § 98.234(a)(2)(i).

- (B) Method 21 as specified in § 98.234(a)(2)(ii).

- (C) Optical gas imaging (OGI) and other leak detection methods as specified in § 98.234(a)(1), (3), or (5).

- (ii) You must accumulate a minimum of 50 leak measurements total for a given component type and leak detection method combination before you can develop and use a facility-specific component-level leaker emission factor for use in calculating emissions according to paragraph (q)(2) of this section (Calculation Method 1: Leaker emission factor calculation methodology).

- (iii) Sum the volumetric flow rate of natural gas determined in accordance with paragraph (q)(3)(i) of this section for each leak by component type and leak detection method as specified in paragraph (q)(4)(i) of this section meeting the minimum number of measurement requirement in paragraph (q)(4)(ii) of this section.

- (iv) Convert the volumetric flow rate of natural gas determined in paragraph (q)(4)(iii) of this section to standard conditions using the method specified in paragraph (t)(1) of this section.

- (v) Determine the emission factor in units of standard cubic feet per hour component (scf/hr-component) by dividing the sum of the volumetric flow rate of natural gas determined in paragraph (q)(4)(iv) of this section by the total number of leak measurements for that component type and leak detection method combination.

- (vi) You must update the emission factor determined in (q)(4)(v) of this section annually to include the results from all complete leak surveys for which leak measurement was performed during the reporting year in accordance with paragraph (q)(3) of this section.

(r) **Equipment leaks by population count.** This paragraph (r) applies to emissions sources listed in § 98.232(c)(21)(ii), (f)(7), (g)(5), (h)(6), (j)(10)(ii), (m)(3)(i), and (m)(4)(i) if you are not required to comply with paragraph (q) of this section and if you do not elect to comply with paragraph (q) of this section for these components in lieu of this paragraph (r). This paragraph (r) also applies to emission sources listed in § 98.232(i)(2) through (6), (j)(11), and (m)(5). To be subject to the requirements of this paragraph (r), the listed emissions sources also must contact streams with gas content greater than 10 percent CH<sub>4</sub> plus CO<sub>2</sub> by weight. Emissions sources that contact streams with gas content less than or equal to 10 percent CH<sub>4</sub> plus CO<sub>2</sub> by weight are exempt from the requirements of this paragraph (r) and do not need to be reported. Tubing systems equal to or less than one half inch diameter are exempt from the requirements of this paragraph (r) and do not need to be reported. Equipment leak components in vacuum service are exempt from the survey and emission estimation requirements of this paragraph (r) and only the count of these equipment must be reported. You must calculate emissions from all emission sources listed in this paragraph (r) using equation W-32A to this section, except for natural gas distribution facility emission sources listed in § 98.232(i)(3). Natural gas distribution facility emission sources listed in § 98.232(i)(3) must calculate emissions using equation W-32B to this section and according to paragraph (r)(6)(ii) of this section.

$$E_{s,e,i} = Count_e * EF_{s,e} * GHG_i * T_e \quad (\text{Eq. W-32A})$$

$$E_{s,MR,i} = Count_{MR} * EF_{s,MR,i} * T_{w,avg} \quad (\text{Eq. W-32B})$$

Where:

$E_{s,e,i}$  = Annual volumetric emissions of GHG<sub>i</sub> from the emission source type in standard cubic feet. The emission source type may be a major equipment (e.g., wellhead, separator), component (e.g., connector, open-ended line), below grade metering-regulating station, below grade transmission-distribution transfer station, distribution main, distribution service, gathering pipeline, transmission company interconnect metering-regulating station, farm tap and/or direct sale metering-regulating station, or transmission pipeline.

$E_{s,MR,i}$  = Annual volumetric emissions of GHG<sub>i</sub> from all meter/regulator runs at above grade metering regulating stations that are not above grade transmission-distribution transfer stations or, when used to calculate emissions according to paragraph (q)(2)(xi) or (q)(3)(viii)(B) of this section, the annual volumetric emissions of GHG<sub>i</sub> from all meter/regulator runs at above grade transmission-distribution transfer stations.

$Count_e$  = Total number of the emission source type at the facility. Onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities must count each major equipment piece listed in table W-1 to this subpart. Onshore petroleum and natural gas gathering and boosting facilities must also count the miles of gathering pipelines by material type (protected steel, unprotected steel, plastic, or cast iron). Underground natural gas storage facilities must count each component listed in table W-3 to this subpart. LNG storage facilities must count the number of vapor recovery compressors. LNG import and export facilities must count the number of vapor recovery compressors. Natural gas distribution facilities must count the: (1) Number of distribution services by material type; (2) miles of distribution mains by material type; (3) number of below grade transmission-distribution transfer stations; and (4) number of below grade metering-regulating stations; as listed in table W-5 to this subpart. Onshore natural gas transmission pipeline facilities must count the following, as listed in table W-5 to this subpart: (1) Miles of transmission pipelines by material type; (2) number of transmission company interconnect metering-regulating stations; and (3) number of farm tap and/or direct sale metering-regulating stations.

$\text{Count}_{\text{MR}}$  = Total number of meter/regulator runs at above grade metering-regulating stations that are not above grade transmission-distribution transfer stations or, when used to calculate emissions according to paragraph (q)(2)(xi) or (q)(3)(viii)(B) of this section, the total number of meter/regulator runs at above grade transmission-distribution transfer stations.

$\text{EF}_{\text{s,e}}$  = Population emission factor for the specific emission source type, as specified in paragraphs (r)(2) through (7) of this section.

$\text{EF}_{\text{s,MR},i}$  = Meter/regulator run population emission factor for  $\text{GHG}_i$  based on all surveyed above grade transmission-distribution transfer stations over “n” years, in standard cubic feet of  $\text{GHG}_i$  per operational hour of all meter/regulator runs, as determined in equation W-31 to this section.

$\text{GHG}_i$  = For onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities, concentration of  $\text{GHG}_i$ ,  $\text{CH}_4$  or  $\text{CO}_2$ , in produced natural gas as defined in paragraph (u)(2) of this section; for onshore natural gas transmission compression and underground natural gas storage,  $\text{GHG}_i$  equals 0.975 for  $\text{CH}_4$  and  $1.1 \times 10^{-2}$  for  $\text{CO}_2$  or concentration of  $\text{GHG}_i$ ,  $\text{CH}_4$  or  $\text{CO}_2$ , in the total hydrocarbon of the feed natural gas; for LNG storage and LNG import and export equipment,  $\text{GHG}_i$  equals 1 for  $\text{CH}_4$  and 0 for  $\text{CO}_2$ ; and for natural gas distribution and onshore natural gas transmission pipeline,  $\text{GHG}_i$  equals 1 for  $\text{CH}_4$  and  $1.1 \times 10^{-2}$   $\text{CO}_2$ .

$T_e$  = Average estimated time that each emission source type associated with the equipment leak emission was operational in the calendar year, in hours, using engineering estimate based on best available data.

$T_{\text{w,avg}}$  = Average estimated time that each meter/regulator run was operational in the calendar year, in hours per meter/regulator run, using engineering estimate based on best available data.

- (1) Calculate both  $\text{CH}_4$  and  $\text{CO}_2$  mass emissions from volumetric emissions using calculations in paragraph (v) of this section.
- (2) Onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities must use the appropriate default whole gas population emission factors listed in table W-1 to this subpart. Major equipment associated with gas wells are considered gas service equipment in table W-1 to this subpart. Onshore petroleum and natural gas gathering and boosting facilities shall use the gas service equipment emission factors in table W-1 to this subpart. Major equipment associated with crude oil wells are considered crude service equipment in table W-1 to this subpart. Where facilities conduct EOR operations, the emission factor listed in table W-1 to this subpart shall be used to estimate all streams of gases, including recycle  $\text{CO}_2$  stream. For meters/piping, use one meters/piping per well-pad for onshore petroleum and natural gas production operations and the number of meters in the facility for onshore petroleum and natural gas gathering and boosting operations.
- (3) Underground natural gas storage facilities must use the appropriate default total hydrocarbon population emission factors for storage wellheads in gas service listed in table W-3 to this subpart.
- (4) LNG storage facilities must use the appropriate default methane population emission factors for LNG storage compressors in gas service listed in table W-5 to this subpart.
- (5) LNG import and export facilities must use the appropriate default methane population emission factors for LNG terminal compressors in gas service listed in table W-5 to this subpart.

- (6) Natural gas distribution facilities must use the appropriate methane emission factors as described in paragraphs (r)(6)(i) and (ii) of this section.
  - (i) Below grade transmission-distribution transfer stations, below grade metering-regulating stations, distribution mains, and distribution services must use the appropriate default methane population emission factors listed in table W-5 to this subpart to estimate emissions from components listed in § 98.232(i)(2), (4), (5), and (6), respectively.
  - (ii) Above grade metering-regulating stations that are not above grade transmission-distribution transfer stations must use the meter/regulator run population emission factor calculated in equation W-31 to this section in accordance with paragraph (q)(2)(x) or (q)(3)(viii)(A) of this section for the components listed in § 98.232(i)(3). Natural gas distribution facilities that do not have above grade transmission-distribution transfer stations are not required to calculate emissions for above grade metering-regulating stations and are not required to report GHG emissions in § 98.236(r)(2)(v).
- (7) Onshore natural gas transmission pipeline facilities must use the appropriate default methane population emission factors listed in table W-5 to this subpart to estimate emissions from components listed in § 98.232(m)(3)(i), (4)(i) and (5).
- (s) **Offshore petroleum and natural gas production facilities.** Calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions for offshore petroleum and natural gas production from all equipment leaks (i.e., fugitives), vented emission, and flare emission source types as identified by BOEM in the most recent monitoring and calculation methods published by BOEM referenced in 30 CFR 550.302 through 304.
  - (1) Offshore production facilities that report to BOEM's emissions inventory must calculate emissions as specified in paragraph (s)(1)(i) or (ii) of this section, as applicable.
    - (i) Report the same annual emissions calculated using the most recent monitoring and calculation methods published by BOEM as referenced in 30 CFR 550.302 through 304 for any reporting year that overlaps with a BOEM emissions inventory year and any other reporting year in which the BOEM's emissions reporting system is available and the facility has the data needed to use BOEM's emissions reporting system.
    - (ii) If BOEM's emissions reporting system is not available or if the facility does not have the data needed to use BOEM's emissions reporting system, adjust emissions from the most recent emissions calculated in accordance with paragraph (s)(1)(i), (s)(3), or (s)(4) of this section, as applicable, by using a ratio of the operating time for the facility in the current reporting year relative to the operating time for the facility during the reporting year for which emissions were calculated as specified in paragraph (s)(1)(i), (s)(3), or (s)(4) of this section, as applicable.
  - (2) Offshore production facilities that do not report to BOEM's emissions inventory must calculate emissions as specified in paragraph (s)(2)(i) or (ii) of this section, as applicable.
    - (i) Use the most recent monitoring and calculation methods published by BOEM as referenced in 30 CFR 550.302 through 304 to calculate annual emissions for any reporting year that overlaps with a BOEM emissions inventory year and any other reporting year in which the facility has the data needed to use BOEM's emissions calculation methods.
    - (ii) If the facility does not have the data needed to use BOEM's calculation methods, adjust emissions from the facility's most recent emissions calculated in accordance with paragraph (s)(2)(i), (s)(3), or (s)(4) of this section, as applicable, by using a ratio of the operating time for

the facility in the current reporting year relative to the operating time for the facility in the reporting year for which the emissions were calculated as specified in paragraph (s)(2)(i), (s)(3), or (s)(4) of this section, as applicable.

- (3) If BOEM's emissions inventory is discontinued or delayed for more than 3 consecutive years, then offshore production facilities shall once in every 3 years use the most recent monitoring and calculation methods published by BOEM referenced in 30 CFR 550.302 through 304 to calculate annual emissions for each of the emission source types covered in BOEM's most recently published calculation methods.
- (4) For the first year of reporting, offshore production facilities must use the most recent monitoring and calculation methods published by BOEM referenced in 30 CFR 550.302 through 304 to calculate and report annual emissions.

(t) **GHG volumetric emissions using actual conditions.** If equation parameters in § 98.233 are already determined at standard conditions as provided in the introductory text in § 98.233, which results in volumetric emissions at standard conditions, then this paragraph does not apply. Calculate volumetric emissions at standard conditions as specified in paragraph (t)(1) or (2) of this section, with actual pressure and temperature determined by engineering estimates based on best available data unless otherwise specified.

- (1) Calculate natural gas volumetric emissions at standard conditions using actual natural gas emission temperature and pressure, and equation W-33 to this section for conversions of  $E_{a,n}$  or conversions of  $FR_a$  (whether sub-sonic or sonic).

$$E_{s,n} = \frac{E_{a,n} * (459.67 + T_s) * P_a}{(459.67 + T_a) * P_s * Z_a} \quad (\text{Eq. W-33})$$

Where:

$E_{s,n}$  = Natural gas volumetric emissions at standard temperature and pressure (STP) conditions in cubic feet, except  $E_{s,n}$  equals  $FR_{s,p}$  for each well p when calculating either subsonic or sonic flowrates under § 98.233(g).

$E_{a,n}$  = Natural gas volumetric emissions at actual conditions in cubic feet, except  $E_{a,n}$  equals  $FR_{a,p}$  for each well p when calculating either subsonic or sonic flowrates under § 98.233(g).

$T_s$  = Temperature at standard conditions (60 °F).

$T_a$  = Temperature at actual emission conditions ( °F).

$P_s$  = Absolute pressure at standard conditions (14.7 psia).

$P_a$  = Absolute pressure at actual conditions (psia).

$Z_a$  = Compressibility factor at actual conditions for natural gas. You may use either a default compressibility factor of 1, or a site-specific compressibility factor based on actual temperature and pressure conditions.

- (2) Calculate GHG volumetric emissions at standard conditions using actual GHG emissions temperature and pressure, and equation W-34 to this section.

$$E_{s,i} = \frac{E_{a,i} * (459.67 + T_s) * P_a}{(459.67 + T_a) * P_s * Z_a} \quad (\text{Eq. W-34})$$

Where:

$E_{s,i}$  = GHG i volumetric emissions at standard temperature and pressure (STP) conditions in cubic feet.

$E_{a,i}$  = GHG i volumetric emissions at actual conditions in cubic feet.

$T_s$  = Temperature at standard conditions (60 °F).

$T_a$  = Temperature at actual emission conditions ( °F).

$P_s$  = Absolute pressure at standard conditions (14.7 psia).

$P_a$  = Absolute pressure at actual conditions (psia).

$Z_a$  = Compressibility factor at actual conditions for GHG<sub>i</sub>. You may use either a default compressibility factor of 1, or a site-specific compressibility factor based on actual temperature and pressure conditions.

(3) Reporters using 68 °F for standard temperature may use the ratio 519.67/527.67 to convert volumetric emissions from 68 °F to 60 °F.

(u) **GHG volumetric emissions at standard conditions.** Calculate GHG volumetric emissions at standard conditions as specified in paragraphs (u)(1) and (2) of this section.

(1) Estimate CH<sub>4</sub> and CO<sub>2</sub> emissions from natural gas emissions using equation W-35 to this section.

$$E_{s,i} = E_{s,n} * M_i \quad (\text{Eq. W-35})$$

Where:

$E_{s,i}$  = GHG i (either CH<sub>4</sub> or CO<sub>2</sub>) volumetric emissions at standard conditions in cubic feet.

$E_{s,n}$  = Natural gas volumetric emissions at standard conditions in cubic feet.

$M_i$  = Mole fraction of GHG i in the natural gas.

(2) For equation W-35 to this section, the mole fraction,  $M_i$ , shall be the annual average mole fraction for each sub-basin category or facility, as specified in paragraphs (u)(2)(i) through (vii) of this section.

(i) **GHG mole fraction in produced natural gas for onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities.** If you have a continuous gas composition analyzer for produced natural gas, you must use an annual average of these values for determining the mole fraction. If you do not have a continuous gas composition analyzer, then you must use an annual average gas composition based on your most recent available analysis of the sub-basin category or facility, as applicable to the emission source.



- (ii) **GHG mole fraction in feed natural gas for all emissions sources upstream of the de-methanizer or dew point control and GHG mole fraction in facility specific residue gas to transmission pipeline systems for all emissions sources downstream of the de-methanizer overhead or dew point control for onshore natural gas processing facilities.** For onshore natural gas processing plants that solely fractionate a liquid stream, use the GHG mole percent in feed natural gas liquid for all streams. If you have a continuous gas composition analyzer on feed natural gas, you must use these values for determining the mole fraction. If you do not have a continuous gas composition analyzer, then annual samples must be taken according to methods set forth in § 98.234(b).
- (iii) **GHG mole fraction in transmission pipeline natural gas that passes through the facility for the onshore natural gas transmission compression industry segment and the onshore natural gas transmission pipeline industry segment.** You may use either a default 95 percent methane and 1 percent carbon dioxide fraction for GHG mole fraction in natural gas or site specific engineering estimates based on best available data.
- (iv) **GHG mole fraction in natural gas stored in the underground natural gas storage industry segment.** You may use either a default 95 percent methane and 1 percent carbon dioxide fraction for GHG mole fraction in natural gas or site specific engineering estimates based on best available data.
- (v) **GHG mole fraction in natural gas stored in the LNG storage industry segment.** You may use either a default 95 percent methane and 1 percent carbon dioxide fraction for GHG mole fraction in natural gas or site specific engineering estimates based on best available data.
- (vi) **GHG mole fraction in natural gas stored in the LNG import and export industry segment.** For export facilities that receive gas from transmission pipelines, you may use either a default 95 percent methane and 1 percent carbon dioxide fraction for GHG mole fraction in natural gas or site specific engineering estimates based on best available data.
- (vii) **GHG mole fraction in local distribution pipeline natural gas that passes through the facility for natural gas distribution facilities.** You may use either a default 95 percent methane and 1 percent carbon dioxide fraction for GHG mole fraction in natural gas or site specific engineering estimates based on best available data.

- (v) **GHG mass emissions.** Calculate GHG mass emissions in metric tons by converting the GHG volumetric emissions at standard conditions into mass emissions using equation W-36 to this section.

$$Mass_i = E_{s,i} * \rho_i * 10^{-3} \quad (\text{Eq. W-36})$$

Where:

Mass<sub>i</sub> = GHG<sub>i</sub> (either CH<sub>4</sub>, CO<sub>2</sub>, or N<sub>2</sub>O) mass emissions in metric tons.

E<sub>s,i</sub> = GHG<sub>i</sub> (either CH<sub>4</sub>, CO<sub>2</sub>, or N<sub>2</sub>O) volumetric emissions at standard conditions, in cubic feet.

ρ<sub>i</sub> = Density of GHG<sub>i</sub>. Use 0.0526 kg/ft<sup>3</sup> for CO<sub>2</sub> and N<sub>2</sub>O, and 0.0192 kg/ft<sup>3</sup> for CH<sub>4</sub> at 60 °F and 14.7 psia.

- (w) **EOR injection pump blowdown.** Calculate CO<sub>2</sub> pump blowdown emissions from each EOR injection pump system as follows:



- (1) Calculate the total injection pump system volume in cubic feet (including pipelines, manifolds and vessels) between isolation valves.
- (2) Retain logs of the number of blowdowns per calendar year.
- (3) Calculate the total annual CO<sub>2</sub> emissions from each EOR injection pump system using equation W-37 to this section:

$$Mass_{CO_2} = N * V_v * R_c * GHG_{CO_2} * 10^{-3} \quad (\text{Eq. W-37})$$

Where:

Mass<sub>CO<sub>2</sub></sub> = Annual EOR injection pump system emissions in metric tons from blowdowns.

N = Number of blowdowns for the EOR injection pump system in the calendar year.

V<sub>v</sub> = Total volume in cubic feet of EOR injection pump system chambers (including pipelines, manifolds and vessels) between isolation valves.

R<sub>c</sub> = Density of critical phase EOR injection gas in kg/ft<sup>3</sup>. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or you may use an industry standard practice to determine density of super critical EOR injection gas.

GHG<sub>CO<sub>2</sub></sub> = Mass fraction of CO<sub>2</sub> in critical phase injection gas.

1 × 10<sup>-3</sup> = Conversion factor from kilograms to metric tons.

(x) **EOR hydrocarbon liquids dissolved CO<sub>2</sub>**. Calculate CO<sub>2</sub> emissions downstream of the storage tank from dissolved CO<sub>2</sub> in hydrocarbon liquids produced through EOR operations as follows:

- (1) Determine the amount of CO<sub>2</sub> retained in hydrocarbon liquids after flashing in tankage at STP conditions. Annual samples of hydrocarbon liquids downstream of the storage tank must be taken according to methods set forth in § 98.234(b) to determine retention of CO<sub>2</sub> in hydrocarbon liquids immediately downstream of the storage tank. Use the annual analysis for the calendar year.
- (2) Estimate emissions using equation W-38 to this section.

$$Mass_{CO_2} = S_{hl} * V_{hl} \quad (\text{Eq. W-38})$$

Where:

Mass<sub>CO<sub>2</sub></sub> = Annual CO<sub>2</sub> emissions from CO<sub>2</sub> retained in hydrocarbon liquids produced through EOR operations beyond tankage, in metric tons.

S<sub>hl</sub> = Amount of CO<sub>2</sub> retained in hydrocarbon liquids downstream of the storage tank, in metric tons per barrel, under standard conditions.

V<sub>hl</sub> = Total volume of hydrocarbon liquids produced at the EOR operations in barrels in the calendar year.

(y) **Other large release events.** Calculate CO<sub>2</sub> and CH<sub>4</sub> emissions from other large release events as specified in paragraphs (y)(2) through (5) of this section for each release that meets or exceeds the applicable criteria in paragraph (y)(1) of this section. You are not required to measure every release from your facility, but if you have EPA-provided notification(s) under the super emitter program in § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or if EPA- or facility-funded monitoring or measurement data that demonstrate the release meets or exceeds one of the thresholds or may reasonably be anticipated to meet or exceed (or to have met or exceeded) one of the thresholds in paragraph (y)(1) of this section, then you must calculate the event emissions and, if the thresholds are confirmed to be exceeded, report the emissions as an other large release event. If you receive an EPA-provided notification under the super emitter program in § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you must comply with the requirements in paragraph (y)(6) of this section.

(1) You must report emissions for other large release events that emit GHG at or above any applicable threshold listed in paragraphs (y)(1)(i) or (ii) of this section. You must report the emissions for the entire duration of the event, not just those time periods of the event emissions exceed the thresholds in paragraphs (y)(1)(i) or (ii) of this section.

(i) For sources not subject to reporting under paragraphs (a) through (s), (w), (x), (dd), or (ee) of this section (such as but not limited to a fire, explosion, well blowout, or pressure relief), a release that emits methane at any point in time at a rate of 100 kg/hr or greater.

(ii) For sources subject to reporting under paragraphs (a) through (h), (j) through (s), (w), (x), (dd), or (ee) of this section, a release that emits methane at any point in time at a rate of 100 kg/hr or greater in excess of the emissions calculated from the source using the applicable methods under paragraphs (a) through (h), (j) through (s), (w), (x), (dd), or (ee) of this section. For a release meeting the criteria in this paragraph (y)(1)(ii), you must report the emissions as an other large release event and exclude the emissions that would have been calculated for that source during the timespan of the event in the source-specific emissions calculated under paragraphs (a) through (h), (j) through (s), (w), (x), (dd), or (ee) of this section, as applicable.

(2) Estimate the total volume of gas released during the event in standard cubic feet and the methane emission rate at any point in time during the event in kilograms per hour using measurement data according to § 98.234(b), if available, or a combination of process knowledge, engineering estimates, and best available data when measurement data are not available according to paragraphs (y)(2)(i) through (v) of this section.

(i) The total volume of gas released must be estimated as the product of the measured or estimated average flow or release rate and the estimated event duration. For events for which information is available showing variable or decaying flow rates, you must calculate the maximum natural gas flow or release rate during the event and either determine a representative average release rate across the entire event or determine representative release rates for specific time periods within the event duration. If you elect to determine representative release rates for specific time periods within the event duration, calculate the volume of gas released for each time period within the event duration as the product of the representative release rate and the length of the corresponding time period and sum the volume of gas released across each of the time periods for the full duration of the event. For events that have releases from multiple release points but have a common root cause (e.g., over-pressuring of a

system causes releases from multiple pressure relief devices), you must report the event as a single other large release event considering the cumulative volume of gas released across all release points.

- (ii) The start time of the event must be determined based on monitored process parameters and sound engineering principles. If monitored process parameters cannot identify the start of the event, the event must be assumed to start on the date of the most recent monitoring or measurement survey that confirms the source was not emitting at or above the rates specified in paragraph (y)(1) of this section or assumed to have started 91 days prior to the date the event was first identified, whichever start date is most recent.
  - (iii) The end time of the event must be the date of the confirmed repair or confirmed cessation of emissions.
  - (iv) For the purposes of paragraph (y)(2)(ii) of this section, "monitoring or measurement survey" includes any monitoring or measurement method in § 98.234(a) through (d) as well as advanced screening methods such as monitoring systems mounted on vehicles, drones, helicopters, airplanes, or satellites capable of identifying emissions at the thresholds specified in paragraph (y)(1) of this section at a 90 percent probability of detection as demonstrated by controlled release tests. Audio, visual, and olfactory inspections are considered monitoring surveys if and only if the event was identified via an audio, visual, and olfactory inspection.
  - (v) For events that span two different reporting years, calculate the portion of the event's volumetric emissions calculated according to paragraph (y)(2)(i) of this section that occurred in each reporting year considering only reporting year 2025 and later reporting years. For events with consistent flow or for which one average emissions rate is used, use the relative duration of the event within each reporting year to apportion the volume of gas released for each reporting year. For variable flow events for which the volume of gas released is estimated for separate time periods, sum the volume of gas released across each of the time periods within a given reporting year separately. If one of the time periods span two different reporting years, calculate the portion of the volumetric emissions calculated for that time period that applies to each reporting year based on the number of hours in that time period within each reporting year.
- (3) Determine the composition of the gas released to the atmosphere using measurement data, if available, or a combination of process knowledge, engineering estimates, and best available data when measurement data are not available. In the event of an explosion or fire, where a portion of the natural gas may be combusted, estimate the composition of the gas released to the atmosphere considering the fraction of natural gas released directly to the atmosphere and the fraction of natural gas that was combusted by the explosion or fire during the release event. Assume combustion efficiency equals destruction efficiency and assume a maximum combustion efficiency of 92 percent for natural gas that is combusted in an explosion or fire when estimating the CO<sub>2</sub> and CH<sub>4</sub> composition of the release. You may use different compositions for different periods within the duration if available information suggests composition varied during the release (e.g., if a portion of the release occurred while fire was present and a portion of the release occurred when no fire was present).
- (4) Calculate the GHG volumetric emissions using equation W-35 to this section.
- (5) Calculate both CH<sub>4</sub> and CO<sub>2</sub> mass emissions from volumetric emissions using calculations in paragraph (v) of this section.

(6) If you receive an EPA-provided notification under the super emitter program in § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you must include the emissions from that source or event within your subpart W report unless you can provide certification as specified in either paragraph (y)(6)(i) or (ii) of this section, as applicable, or unless the EPA has determined that the notification has a demonstrable error, as specified in paragraph (y)(6)(iii) of this section.

(i) If you do not own or operate any petroleum and natural gas system equipment within 50 meters of the location identified in the notification, you may prepare and submit the certification that the facility does not own or operate the equipment at the location identified in the notification.

(ii) If you own or operate petroleum and natural gas system equipment within 50 meters of the location identified in the notification, but there are also other petroleum and natural gas system equipment within 50 meters of the location identified in the notification owned and operated by a different facility, you may prepare and submit the certification that the facility does not own or operate the emitting equipment at the location identified in the notification if and only if you comply with all of the following requirements.

(A) Within 5 days of receiving the notification, complete an investigation of available data as specified in § 60.5371b(d)(2)(i) through (iv) of this chapter to identify the emissions source related to the event notification.

(B) If the data investigation in paragraph (y)(6)(ii)(A) of this section does not identify the emissions source related to the event notification, you must conduct a complete survey of equipment at your facility that is within 50 meters of the location identified in the notification following any one of the methods provided in § 98.234(a)(1) through (3) within 15 days of receiving the notification.

(C) The investigations and surveys conducted in paragraphs (y)(6)(ii)(A) and (B) of this section verify that none of the equipment that you own or operate at the location identified in the notification were responsible for the high emissions event.

(iii) For consideration of demonstrable error, you must submit a statement of demonstrable error as specified by § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter. You must report emissions associated with the notification unless the EPA has determined that the notification contained a demonstrable error.

(z) **Combustion equipment.** Except as specified in paragraphs (z)(6) and (7) of this section, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion-related emissions from stationary or portable equipment using the applicable method in paragraphs (z)(1) through (3) of this section according to the fuel combusted as specified in those paragraphs:

(1) If a fuel combusted in the stationary or portable equipment meets the specifications of paragraph (z)(1)(i) of this section, then calculate emissions according to paragraph (z)(1)(ii) of this section.

(i) The fuel combusted in the stationary or portable equipment is listed in table C-1 to subpart C of this part or is a blend in which all fuels are listed in table C-1. If the fuel is natural gas or the blend contains natural gas, the natural gas must also meet the criteria of paragraphs (z)(1)(i)(A) and (B) of this section.

(A) The natural gas must be of pipeline quality specification.

- (B) The natural gas must have a minimum higher heating value of 950 Btu per standard cubic foot.
  - (ii) For fuels listed in paragraph (z)(1)(i) of this section, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions for each unit or group of units combusting the same fuel according to any Tier listed in subpart C of this part, except that each natural gas-fired reciprocating internal combustion engine or gas turbine must use one of the methods in paragraph (z)(4) of this section to quantify a CH<sub>4</sub> emission factor instead of using the CH<sub>4</sub> emission factor in table C-2 to subpart C of this part. You must follow all applicable calculation requirements for that tier listed in § 98.33, any monitoring or QA/QC requirements listed for that tier in § 98.34, any missing data procedures specified in § 98.35, and any recordkeeping requirements specified in § 98.37. You must report emissions according to paragraph (z)(5) of this section.
- (2) If a fuel combusted in the stationary or portable equipment meets the specifications of paragraph (z)(2)(i) of this section, then calculate emissions according to paragraph (z)(2)(ii) of this section.
- (i) The fuel combusted in the stationary or portable equipment is natural gas that is not pipeline quality or it is a blend containing natural gas that is not pipeline quality with only fuels that are listed in table C-1. The natural gas must meet the criteria of paragraphs (z)(2)(i)(A) through (C) of this section.
    - (A) The natural gas must have a minimum higher heating value of 950 Btu per standard cubic foot.
    - (B) The natural gas must have a maximum higher heating value of 1,100 Btu per standard cubic foot.
    - (C) The natural gas must have a minimum CH<sub>4</sub> content of 70 percent by volume.
  - (ii) For fuels listed in paragraph (z)(2)(i) of this section, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions for each unit or group of units combusting the same fuel according to Tier 2, Tier 3, or Tier 4 listed in subpart C of this part, except that each natural gas-fired reciprocating engine or gas turbine must use one of the methods in paragraph (z)(4) of this section to quantify a CH<sub>4</sub> emission factor instead of using the CH<sub>4</sub> emission factor in table C-2 to subpart C of this part. You must follow all applicable calculation requirements for that tier listed in § 98.33, any monitoring or QA/QC requirements listed for that tier in § 98.34, any missing data procedures specified in § 98.35, and any recordkeeping requirements specified in § 98.37. You must report emissions according to paragraph (z)(5) of this section.
- (3) If a fuel combusted in the stationary or portable equipment meets the specifications of paragraph (z)(3)(i) of this section, then calculate emissions according to paragraph (z)(3)(ii) of this section.
- (i) The fuel combusted in the stationary or portable equipment does not meet the criteria of either paragraph (z)(1)(i) or (z)(2)(i) of this section. Examples include natural gas that is not of pipeline quality, natural gas that has a higher heating value of less than 950 Btu per standard cubic feet, and natural gas that is not pipeline quality and does not meet the criteria of either paragraph (z)(2)(i)(B) or (C) of this section. Other examples include field gas that does not meet the definition of natural gas in § 98.238 and blends containing field gas that does not meet the definition of natural gas in § 98.238.

- (ii) For fuels listed in paragraph (z)(3)(i) of this section, calculate combustion emissions for each unit or group of units combusting the same fuel using the applicable steps from paragraphs (z)(3)(ii)(A) through (G) of this section:
- (A) You may use company records to determine the volume of fuel combusted in the unit or group of units during the reporting year.
  - (B) If you have a continuous gas composition analyzer on fuel to the combustion unit(s), you must use these compositions for determining the concentration of each constituent in the flow of gas to the unit or group of units. If you do not have a continuous gas composition analyzer on gas to the combustion unit(s), you may use engineering estimates based on best available data to determine the concentration of each constituent in the flow of gas to the unit or group of units. Otherwise, you must use the appropriate gas compositions for each stream going to the combustion unit(s) as specified in paragraph (u)(2) of this section.
  - (C) For reciprocating internal combustion engines or gas turbines, you may conduct a performance test following the applicable procedures in § 98.234(i) and calculate CH<sub>4</sub> emissions in accordance with paragraph (z)(3)(ii)(G) of this section. Otherwise, you must calculate CH<sub>4</sub> emissions in accordance with paragraphs (z)(3)(ii)(D) through (F) of this section.
  - (D) Calculate GHG volumetric emissions at actual conditions using equations W-39A and W-39B to this section:

$$E_{a,CO_2} = (V_a * Y_{CO_2}) + \eta * \sum_{j=1}^5 V_a * Y_j * R_j \quad (\text{Eq. W-39A})$$

$$E_{a,CH_4} = V_a * (1 - \eta) * Y_{CH_4} \quad (\text{Eq. W-39B})$$

Where:

$E_{a,CO_2}$  = Contribution of annual CO<sub>2</sub> emissions from portable or stationary fuel combustion sources in cubic feet, under actual conditions.

$V_a$  = Volume of gas sent to the combustion unit or group of units in actual cubic feet, during the year.

$Y_{CO_2}$  = Mole fraction of CO<sub>2</sub> in gas sent to the combustion unit or group of units.

$\eta$  = Fraction of gas combusted for portable and stationary equipment determined using engineering estimation. For internal combustion devices that are not reciprocating internal combustion engines or gas turbines, a default of 0.995 can be used. For two-stroke lean-burn reciprocating internal combustion engines, a default of 0.953 must be used; for four-stroke lean-burn reciprocating internal combustion engines, a default of 0.962 must be used; for four-stroke rich-burn reciprocating internal combustion engines, a default of 0.997 must be used, and for gas turbines, a default of 0.999 must be used.

$Y_j$  = Mole fraction of hydrocarbon constituent j (such as methane, ethane, propane, butane, and pentanes plus) in gas sent to the combustion unit or group of units.

$R_j$  = Number of carbon atoms in the hydrocarbon constituent  $j$  in gas sent to the combustion unit or group of units; 1 for methane, 2 for ethane, 3 for propane, 4 for butane, and 5 for pentanes plus.

$E_{a,CH_4}$  = Contribution of annual  $CH_4$  emissions from portable or stationary fuel combustion sources in cubic feet, under actual conditions.

$Y_{CH_4}$  = Mole fraction of methane in gas sent to the combustion unit or group of units.

- (E) Calculate GHG volumetric emissions at standard conditions using calculations in paragraph (t) of this section.
- (F) Calculate both combustion-related  $CH_4$  and  $CO_2$  mass emissions from volumetric  $CH_4$  and  $CO_2$  emissions using calculation in paragraph (v) of this section.
- (G) Calculate  $CH_4$  and  $N_2O$  mass emissions, as applicable, using equation W-40 to this section.

$$Mass_i = (1 \times 10^{-3}) \times Fuel \times HHV \times EF_i \quad (Eq. W-40)$$

Where:

$Mass_i$  = Annual  $N_2O$  or  $CH_4$  emissions from the combustion of a particular type of fuel (metric tons).

Fuel = Annual mass or volume of the fuel combusted (mass or volume per year, choose appropriately to be consistent with the units of HHV).

HHV = Site-specific higher heating value of the fuel, mmBtu/unit of the fuel (in units consistent with the fuel quantity combusted).

$EF_i$  = For  $N_2O$ , use  $1.0 \times 10^{-4}$  kg  $N_2O$ /mmBtu; for  $CH_4$ , use the  $CH_4$  EF (kg  $CH_4$ /MMBtu) determined from your performance test according to paragraph (z)(4)(i) of this section.

$1 \times 10^{-3}$  = Conversion factor from kilograms to metric tons.

- (4) For each natural gas-fired reciprocating internal combustion engine or gas turbine calculating emissions according to paragraph (z)(1)(ii) or (z)(2)(ii) of this section, you must determine a  $CH_4$  emission factor (kg  $CH_4$ /MMBtu) using one of the methods provided in paragraphs (z)(4)(i) through (iii) of this section. For each reciprocating internal combustion engine or gas turbine calculating  $CH_4$  emissions according to paragraph (z)(3)(ii)(G) of this section, you must determine a  $CH_4$  emission factor (kg  $CH_4$ /MMBtu) using the method provided in paragraph (z)(4)(i).
  - (i) Conduct a performance test following the applicable procedures in § 98.234(i). If you are required or elect to conduct a performance test for any reason, you must use that result to determine the  $CH_4$  emission factors. If multiple performance tests are conducted in the same reporting year, the arithmetic average of all performance tests completed that year must be used to determine the  $CH_4$  emission factor.
  - (ii) Original equipment manufacturer information, which may include manufacturer specification sheets, emissions certification data, or other manufacturer data providing expected emission rates from the reciprocating internal combustion engine or gas turbine.

(iii) Applicable equipment type-specific emission factor from table W-7 to this subpart.

- (5) Emissions from fuel combusted in stationary or portable equipment at onshore petroleum and natural gas production facilities, at onshore petroleum and natural gas gathering and boosting facilities, and at natural gas distribution facilities that are calculated according to the procedures in either paragraph (z)(1)(ii) or (z)(2)(ii) of this section must be reported according to the requirements specified in § 98.236(z) rather than the reporting requirements specified in subpart C of this part.
- (6) External fuel combustion sources with a rated heat capacity equal to or less than 5 mmBtu/hr do not need to report combustion emissions or include these emissions for threshold determination in § 98.231(a). You must report the type and number of each external fuel combustion unit.
- (7) Internal fuel combustion sources, not compressor-drivers, with a rated heat capacity equal to or less than 1 mmBtu/hr (or the equivalent of 130 horsepower), do not need to report combustion emissions or include these emissions for threshold determination in § 98.231(a). You must report the type and number of each internal fuel combustion unit.

(aa) through (cc) [Reserved]

(dd) **Drilling mud degassing.** Calculate annual volumetric CH<sub>4</sub> emissions from the degassing of drilling mud using one of the calculation methods described in paragraphs (dd)(1), (2), or (3) of this section. If you have taken mudlogging measurements from the penetration of the first hydrocarbon bearing zone until drilling mud ceases to be circulated in the wellbore, including mud pumping rate and gas trap-derived gas concentration that is reported in parts per million (ppm) or is reported in units from which ppm can be derived, you must use Calculation Method 1 as described in paragraph (dd)(1) of this section. If you have not taken mudlogging measurements, you must use Calculation Method 2 as described in paragraph (dd)(2) of this section. If you have taken mudlogging measurements for some, but not all, of the time the well bore has penetrated the first hydrocarbon bearing zone until drilling mud ceases to be circulated in the wellbore including mud pumping rate and gas trap-derived gas concentration that is reported in parts per million (ppm) or is reported in units from which ppm can be derived, you must use Calculation Method 3 as described in paragraph (dd)(3) of this section.

- (1) **Calculation Method 1.** For each well in the sub-basin in which drilling mud was used during well drilling, you must calculate CH<sub>4</sub> emissions from drilling mud degassing by applying an emissions rate derived from a representative well in the same sub-basin and within the equivalent stratigraphic interval. You must follow the procedures specified in paragraph (dd)(1)(i) of this section to calculate CH<sub>4</sub> emissions for the representative well and follow the procedures in paragraphs (dd)(1)(ii) through (iv) of this section to calculate CH<sub>4</sub> emissions for every well drilled in the sub-basin and within the equivalent stratigraphic interval.
  - (i) Calculate CH<sub>4</sub> emissions from mud degassing for one representative well in each sub-basin and within the equivalent stratigraphic interval. For the representative well, you must use mudlogging measurements, including gas trap derived gas concentration and mud pumping rate, taken during the reporting year. In the first year of reporting, you may use measurements from the prior reporting year if measurements from the current reporting year are not available. Use equation W-41 to this section to calculate natural gas emissions from mud degassing at the representative well. You must identify and calculate CH<sub>4</sub> emissions for a representative well for the sub-basin and within the equivalent stratigraphic interval every 2 calendar years or on a more frequent basis. If a representative well is not available in the same sub-basin and within the equivalent stratigraphic interval, you may choose a well within the facility that is drilled into the same formation and within the equivalent stratigraphic interval.



$$E_{s,CH_4,r} = MR_r \times T_r \times \frac{X_n}{1,000,000} \times GHG_{CH_4} \times 0.1337 \quad (\text{Eq. W-41})$$

Where:

$E_{s,CH_4,r}$  = Annual total volumetric  $CH_4$  emissions from mud degassing for the representative well,  $r$ , in standard cubic feet.

$MR_r$  = Average mud rate for the representative well,  $r$ , in gallons per minute.

$T_r$  = Total time that drilling mud is circulated in the representative well,  $r$ , in minutes beginning with initial penetration of the first hydrocarbon-bearing zone until drilling mud ceases to be circulated in the wellbore.

$X_n$  = Average concentration of natural gas in the drilling mud as measured by the gas trap, in parts per million.

$GHG_{CH_4}$  = Measured mole fraction of  $CH_4$  in natural gas entrained in the drilling mud.

0.1337 = Conversion from gallons to standard cubic feet.

- (ii) Calculate the emissions rate of  $CH_4$  in standard cubic feet per minute from the representative well using equation W-42 to this section.

$$ER_{s,CH_4,r} = \frac{E_{s,CH_4,r}}{T_r} \quad (\text{Eq. W-42})$$

Where:

$ER_{s,CH_4,r}$  = Volumetric  $CH_4$  emission rate from mud degassing for the representative well,  $r$ , in standard cubic feet per minute.

$E_{s,CH_4,r}$  = Annual total volumetric  $CH_4$  emissions from mud degassing for the representative well,  $r$ , in standard cubic feet.

$T_r$  = Total time that drilling mud is circulated in the representative well,  $r$ , in minutes beginning with initial penetration of the first hydrocarbon-bearing zone until drilling mud ceases to be circulated in the wellbore.

- (iii) Use equation W-43 to this section to calculate emissions for any wells drilled in the same sub-basin and within the equivalent stratigraphic interval in the reporting year.

$$E_{s,CH_4,p} = ER_{s,CH_4,r} \times T_p \quad (\text{Eq. W-43})$$

Where:

$E_{s,CH_4,p}$  = Annual total  $CH_4$  emissions from mud degassing for the well,  $p$ , in standard cubic feet.

$ER_{s,CH_4,r}$  = Volumetric  $CH_4$  emission rate from mud degassing for the representative well,  $r$ , in standard cubic feet per minute.

$T_p$  = Total time that drilling mud is circulated in the well, p, during the reporting year, in minutes beginning with initial penetration of the first hydrocarbon-bearing zone until drilling mud ceases to be circulated in the wellbore.

(iv) Calculate  $\text{CH}_4$  mass emissions using calculations in paragraph (v) of this section.

(2) **Calculation Method 2.** If you did not take mudlogging measurements, calculate emissions from mud degassing for each well using equation W-44 to this section:

$$\text{Mass}_{\text{CH}_4,p} = EF_{\text{CH}_4} \times DD_p \times \frac{X_{\text{CH}_4}}{83.85} \quad (\text{Eq. W-44})$$

Where:

$\text{Mass}_{\text{CH}_4,p}$  = Annual total  $\text{CH}_4$  emissions for the well, p, in metric tons.

$EF_{\text{CH}_4}$  = Emission factor in metric tons  $\text{CH}_4$  per drilling day. Use 0.2605 for water-based drilling muds, 0.0586 for oil-based drilling muds, and 0.0586 for synthetic drilling muds.

$DD_p$  = Total number of drilling days for the well, p, when drilling mud is circulated in the wellbore. The first drilling day is the day that the borehole penetrated the first hydrocarbon-bearing zone and the last drilling day is the day drilling mud ceases to be circulated in the wellbore.

$X_{\text{CH}_4}$  = The mole percent of methane in gas vented during mud degassing in the sub-basin in which the well is located and derived from the average mole fraction of  $\text{CH}_4$  in produced gas for the sub-basin as reported in § 98.236(aa)(1)(ii)(I).

83.85 = The mole percent of methane from the vented gas used to derive the emission factor (EF).

(3) **Calculation Method 3.** If you have taken mudlogging measurements at intermittent time intervals for some, but not all, of the time the well bore has penetrated the first hydrocarbon bearing zone until drilling mud ceases to be circulated in the wellbore, you must use Calculation Method 1 to calculate emissions for the cumulative amount of time mudlogging measurements were taken and Calculation Method 2 for the cumulative amount of time mudlogging measurements were not taken. To determine total annual  $\text{CH}_4$  emissions for the well, add  $\text{Mass}_{\text{CH}_4,p}$  calculated using Calculation Method 2 to  $E_{s,\text{CH}_4,p}$ , if the well is a representative well, or  $E_{s,\text{CH}_4,p}$ , if the well is not a representative well, calculated using Calculation Method 1.

(ee) **Crankcase venting.** For each reciprocating internal combustion engine with a rated heat capacity greater than 1 mmBtu/hr (or the equivalent of 130 horsepower), calculate annual  $\text{CH}_4$  mass emissions from crankcase venting using one of the methods provided in paragraphs (ee)(1) and (2) of this section. If you elect to use the method in paragraph (ee)(1) of this section, you must use the results of the direct measurement to determine the  $\text{CH}_4$  emissions. If any crankcase vents are routed to a flare, you must calculate  $\text{CH}_4$ ,  $\text{CO}_2$ , and  $\text{N}_2\text{O}$  emissions for the flare stack as specified in paragraph (n) of this section and report emissions from the flare as specified in § 98.236(n). Notwithstanding the calculation and emissions reporting requirements as specified in this paragraph (ee) of this section, the number of reciprocating internal combustion engines with crankcase vents routed to flares must be reported as specified in § 98.236(ee)(1).

- (1) **Calculation Method 1.** Determine the CH<sub>4</sub> mass emissions from reciprocating internal combustion engines annually using the method provided in paragraphs (ee)(1)(i) through (iv) of this section. If you choose to use this method you must use it for all reciprocating internal combustion engines at the facility, well-pad site, or gathering and boosting site, except that if you choose to perform the screening specified in paragraph (ee)(1)(ii) of this section, you must use the method in paragraph (ee)(2) of this section to determine emissions from each reciprocating internal combustion engine that is not operating at the facility, well-pad site, or gathering and boosting site at the time of the screening.
- (i) Determine the volumetric flow from the crankcase vent at standard conditions using an appropriate meter, calibrated bag, or high volume sampler according to methods set forth in § 98.234(b), (c), and (d), respectively. Each measurement must be conducted within 10 percent of 100 percent peak load. You may not measure during period of startup, shutdown, or malfunction.
  - (ii) You may choose to use any of the methods set forth in § 98.234(a)(1) through (3) to screen for emissions. If emissions are detected using the methods set forth in § 98.234(a)(1) through (3), then you must use one of the methods specified in paragraphs (ee)(1)(i) of this section to determine the volumetric flow from the crank case vent at standard conditions. If emissions are not detected using the methods in § 98.234(a)(1) through (3), then you may assume that the emissions are zero. For the purposes of this paragraph, when using any of the methods in § 98.234(a)(1) through (3), emissions are detected whenever a leak is detected according to the method.
  - (iii) If conducting measurements for a manifolded group of crankcase vent sources, you must measure at a single point in the manifold downstream of all crankcase vent inputs and, if practical, prior to comingling with other non-compressor emission sources. Determine the volumetric flow at standard conditions from the common stack using one of the methods specified in paragraph (ee)(1)(i) of this section. If the manifolded group contains only crankcase vent sources, divide the measured volumetric flow equally between all operating reciprocating internal combustion engines. If the manifolded group contains crankcase vent sources and compressor vent sources, follow the methods for manifolded sources provided in paragraphs (o) or (p) of this section, as applicable, and report emissions from the crankcase vent as specified in § 98.236(o) or (p), as applicable.
  - (iv) Using equation W-45 to this section, calculate the annual volumetric CH<sub>4</sub> emissions for each reciprocating internal combustion engine that was measured during the reporting year.

$$E_{CH_4} = MT_{s,CCV} \times GHG_{CH_4} \times T \quad (\text{Eq. W-45})$$

Where:

$E_{CH_4}$  = Annual total volumetric emissions of CH<sub>4</sub> from crankcase venting on the reciprocating internal combustion engine, in standard cubic feet.

$MT_{s,CCV}$  = Volumetric gas emissions for measured crankcase vent, in standard cubic feet per hour, measured according to paragraph (ee)(1)(i) of this section.

$GHG_{CH_4}$  = Concentration of  $CH_4$  in the gas stream entering reciprocating internal combustion engine. If the concentration of  $CH_4$  is unknown, use the concentration of  $CH_4$  in the gas stream either using engineering estimates based on best available data or as defined in paragraph (u)(2) of this section.

T = Total operating hours per year for the reciprocating internal combustion engine.

(v) You must calculate  $CH_4$  mass emissions from volumetric emissions using calculations in paragraph (v) of this section.

(2) Calculation Method 2. Calculate annual  $CH_4$  mass emissions from crankcase venting for each reciprocating internal combustion engine using equation W-46 to this section:

$$E_{CH_4} = EF \times 0.001 \times T \quad (\text{Eq. W-46})$$

Where:

$E_{CH_4}$  = Annual total mass emissions of  $CH_4$  from crankcase venting on the reciprocating internal combustion engine, in metric tons.

EF = Emission factor for crankcase venting on the reciprocating internal combustion engine, in kilograms  $CH_4$  per hour per reciprocating internal combustion engine. Use 0.083 kilograms  $CH_4$  per hour per reciprocating internal combustion engine for sources in the onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting industry segments. Use 0.11 kilograms  $CH_4$  per hour per reciprocating internal combustion engine for sources in all other applicable industry segments.

0.001 = Conversion from kilograms to metric tons.

T = Total operating hours per year for the reciprocating internal combustion engine.

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## § 98.234 Monitoring and QA/QC requirements.

The GHG emissions data for petroleum and natural gas emissions sources must be quality assured as applicable as specified in this section. Offshore petroleum and natural gas production facilities shall adhere to the monitoring and QA/QC requirements as set forth in 30 CFR part 550.

(a) You must use any of the methods described in paragraphs (a)(1) through (5) of this section to conduct leak detection(s) of through-valve leakage from all source types listed in § 98.233(k), (o), and (p) that occur during a calendar year. You must use any of the methods described in paragraphs (a)(1) through (7) of this section to conduct leak detection(s) of equipment leaks from components as specified in § 98.233(q)(1)(i) that occur during a calendar year. You must use any of the methods described in paragraphs (a)(1) through (5) of this section to conduct leak detection(s) of equipment leaks from components as specified in § 98.233(q)(1)(ii) that occur during a calendar year. You must use one of the methods described in paragraph (a)(6) or (7) of this section to conduct leak detection(s) of equipment leaks from components as specified in § 98.233(q)(1)(iii). If electing to comply with § 98.233(q) as

specified in § 98.233(q)(1)(iv), you must use any of the methods described in paragraphs (a)(1) through (7) of this section to conduct leak detection(s) of equipment leaks from component types as specified in § 98.233(q)(1)(iv) that occur during a calendar year.

- (1) **Optical gas imaging instrument.** Use an optical gas imaging instrument for equipment leak detection as specified in either paragraph (a)(1)(i), (ii), or (iii) of this section. You may use any of the methods as specified in paragraphs (a)(1)(i) through (iii) of this section unless you are required to use a specific method in § 98.233(q)(1).
  - (i) **Optical gas imaging instrument as specified in § 60.18 of this chapter.** Use an optical gas imaging instrument for equipment leak detection in accordance with 40 CFR part 60, subpart A, § 60.18 of the *Alternative work practice for monitoring equipment leaks*, § 60.18(i)(1)(i); § 60.18(i)(2)(i) except that the minimum monitoring frequency shall be annual using the detection sensitivity level of 60 grams per hour as stated in 40 CFR part 60, subpart A, Table 1: *Detection Sensitivity Levels*; § 60.18(i)(2)(ii) and (iii) except the gas chosen shall be methane, and § 60.18(i)(2)(iv) and (v); § 60.18(i)(3); § 60.18(i)(4)(i) and (v); including the requirements for daily instrument checks and distances, and excluding requirements for video records. Any emissions detected by the optical gas imaging instrument from an applicable component is a leak. In addition, you must operate the optical gas imaging instrument to image the source types required by this subpart in accordance with the instrument manufacturer's operating parameters.
  - (ii) **Optical gas imaging instrument as specified in § 60.5397a of this chapter.** Use an optical gas imaging instrument for equipment leak detection in accordance with § 60.5397a (c)(3) and (7), and (e) of this chapter and paragraphs (a)(1)(ii)(A) through (C) of this section.
    - (A) For the purposes of this subpart, any visible emissions observed by the optical gas imaging instrument from a component required or elected to be monitored as specified in § 98.233(q)(1) is a leak.
    - (B) For the purposes of this subpart, the term “fugitive emissions component” in § 60.5397a of this chapter means “component.”
    - (C) For the purpose of complying with § 98.233(q)(1)(iv), the phrase “the collection of fugitive emissions components at well sites and compressor stations” in § 60.5397a of this chapter means “the collection of components for which you elect to comply with § 98.233(q)(1)(iv).”
  - (iii) **Optical gas imaging instrument as specified in appendix K to part 60 of this chapter.** Use an optical gas imaging instrument for equipment leak detection in accordance with appendix K to part 60, *Determination of Volatile Organic Compound and Greenhouse Gas Leaks Using Optical Gas Imaging*. Any emissions detected by the optical gas imaging instrument from an applicable component is a leak.
- (2) **Method 21.** Use the equipment leak detection methods in Method 21 in appendix A-7 to part 60 of this chapter as specified in paragraph (a)(2)(i) or (ii) of this section. You may use either of the methods as specified in paragraphs (a)(2)(i) and (ii) of this section unless you are required to use a specific method in § 98.233(q)(1). You must survey all applicable source types at the facility needed to conduct a complete equipment leak survey as defined in § 98.233(q)(1). For the purposes of this subpart, the term “fugitive emissions component” in § 60.5397a of this chapter and § 60.5397b of this chapter means “component.”

- (i) **Method 21 with a leak definition of 10,000 ppm.** Use the equipment leak detection methods in Method 21 in appendix A-7 to part 60 of this chapter using methane as the reference compound. If an instrument reading of 10,000 ppm or greater is measured for any applicable component, a leak is detected.
  - (ii) **Method 21 with a leak definition of 500 ppm.** Use the equipment leak detection methods in Method 21 in appendix A-7 to part 60 of this chapter using methane as the reference compound. If an instrument reading of 500 ppm or greater is measured for any applicable component, a leak is detected.
- (3) **Infrared laser beam illuminated instrument.** Use an infrared laser beam illuminated instrument for equipment leak detection. Any emissions detected by the infrared laser beam illuminated instrument is a leak. In addition, you must operate the infrared laser beam illuminated instrument to detect the source types required by this subpart in accordance with the instrument manufacturer's operating parameters.
- (4) [Reserved]
- (5) **Acoustic leak detection device.** Use the acoustic leak detection device to detect through-valve leakage. When using the acoustic leak detection device to quantify the through-valve leakage, you must use the instrument manufacturer's calculation methods to quantify the through-valve leak. When using the acoustic leak detection device, if a leak of 3.1 scf per hour or greater is calculated, a leak is detected. In addition, you must operate the acoustic leak detection device to monitor the source valves required by this subpart in accordance with the instrument manufacturer's operating parameters. Acoustic stethoscope type devices designed to detect through valve leakage when put in contact with the valve body and that provide an audible leak signal but do not calculate a leak rate can be used to identify through-valve leakage. For these acoustic stethoscope type devices, a leak is detected if an audible leak signal is observed or registered by the device. If the acoustic stethoscope type device is used as a screening to a measurement method and a leak is detected, the leak must be measured using any one of the methods specified in paragraphs (b) through (d) of this section.
- (b) You must operate and calibrate all flow meters, composition analyzers and pressure gauges used to measure quantities reported in § 98.233 according to the procedures in § 98.3(i) and the procedures in paragraph (b) of this section. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or you may use an industry standard practice. Consensus-based standards organizations include, but are not limited to, the following: ASTM International, the American National Standards Institute (ANSI), the American Gas Association (AGA), the American Society of Mechanical Engineers (ASME), the American Petroleum Institute (API), and the North American Energy Standards Board (NAESB).
- (c) Use calibrated bags (also known as vent bags) only where the emissions are at near-atmospheric pressures and below the maximum temperature specified by the vent bag manufacturer such that the bag is safe to handle. The bag opening must be of sufficient size that the entire emission can be tightly encompassed for measurement till the bag is completely filled.
  - (1) Hold the bag in place enclosing the emissions source to capture the entire emissions and record the time required for completely filling the bag. If the bag inflates in less than one second, assume one second inflation time.
  - (2) Perform three measurements of the time required to fill the bag, report the emissions as the average of the three readings.

- (3) Estimate natural gas volumetric emissions at standard conditions using calculations in § 98.233(t).
  - (4) Estimate CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions from volumetric natural gas emissions using the calculations in § 98.233(u) and (v).
- (d) Use a high volume sampler to measure emissions within the capacity of the instrument.
- (1) A technician following manufacturer instructions shall conduct measurements, including equipment manufacturer operating procedures and measurement methods relevant to using a high volume sampler, including positioning the instrument for complete capture of the equipment leak without creating backpressure on the source.
  - (2) If the high volume sampler, along with all attachments available from the manufacturer, is not able to capture all the emissions from the source then use anti-static wraps or other aids to capture all emissions without violating operating requirements as provided in the instrument manufacturer's manual.
  - (3) For high volume samplers that output methane mass emissions, you must use the calculations in § 98.233(u) and (v) in reverse to determine the natural gas volumetric emissions at standard conditions. For high volume samplers that output methane volumetric flow in actual conditions, divide the volumetric methane flow rate by the mole fraction of methane in the natural gas according to the provisions in § 98.233(u) and estimate natural gas volumetric emissions at standard conditions using calculations in § 98.233(t). Estimate CH<sub>4</sub> and CO<sub>2</sub> volumetric and mass emissions from volumetric natural gas emissions using the calculations in § 98.233(u) and (v).
  - (4) Calibrate the instrument at 2.5 percent methane with 97.5 percent air and 100 percent CH<sub>4</sub> by using calibrated gas samples and by following manufacturer's instructions for calibration.
  - (5) If the measured methane flow exceeds the manufacturer's reported quantitation limit or if the measured natural gas flow determined as specified in paragraph (d)(3) of this section exceeds 70 percent of the manufacturer's reported maximum sampling flow rate, then the flow exceeds the capacity of the instrument and you must either use a temporary or permanent flow meter according to paragraph (b) of this section or use calibrated bags according to paragraph (c) of this section to determine the leak or flow rate. If you elect to use OGI to demonstrate that 100 percent of the flow is captured by the high volume sampler throughout the measurement period, then the measured flow rate above the 70 percent maximum sampling rate provision can be used. However, if any emissions are observed via OGI escaping capture of the high volume sampler during a measurement period, then that measurement is considered invalid (*i.e.*, considered to be exceeding the quantitation capacity of the device) even if the measured flow rate is less than 70 percent of the sampling rate and you must either use a temporary or permanent flow meter according to paragraph (b) of this section or use calibrated bags according to paragraph (c) of this section to determine the leak or flow rate.

- (e) Peng Robinson Equation of State means the equation of state defined by equation W-47 to this section:

$$p = \frac{RT}{V_m - b} - \frac{a\alpha}{V_m^2 + 2bV_m - b^2} \quad (\text{Eq. W-47})$$

Where:

p = Absolute pressure.



R = Universal gas constant.

T = Absolute temperature.

V<sub>m</sub> = Molar volume.

$$a = \frac{0.45724R^2T_c^2}{P_c}$$

$$b = \frac{0.7780RT_c}{P_c}$$

$$\alpha = \left( 1 + \left( 0.37464 + 1.54226\omega - 0.26992\omega^2 \right) \left( 1 - \sqrt{\frac{T}{T_c}} \right) \right)^2$$

Where:

ω = Acentric factor of the species.

T<sub>c</sub> = Critical temperature.

P<sub>c</sub> = Critical pressure.

(f) [Reserved]

(g) [Reserved]

(h) For well venting for liquids unloading, if a monitoring period other than the full calendar year is used to determine the cumulative amount of time in hours of venting for each well (the term "T<sub>p</sub>" in Equation W-7A and W-7B of § 98.233) or the number of unloading events per well (the term "V<sub>p</sub>" in Equations W-8 and W-9 of § 98.233), then the monitoring period must begin before February 1 of the reporting year and must not end before December 1 of the reporting year. The end of one monitoring period must immediately precede the start of the next monitoring period for the next reporting year. All production days must be monitored and all venting accounted for.

(i) You must use any of the applicable methods described in paragraphs (i)(1) through (4) of this section to conduct a performance test to determine the concentration of CH<sub>4</sub> in the exhaust gas. This concentration must be used to develop a CH<sub>4</sub> emission factor (kg/MMBtu) for estimating combustion slip from reciprocating internal combustion engines or gas turbines as specified in § 98.233(z)(4). You may not



conduct performance tests during period of startup, shutdown or malfunction. You must conduct three separate test runs for each performance test. Each test run must be conducted within 10 percent of 100 percent peak (or the highest achievable) load and last at least 1 hour.

- (1) EPA Method 18 in appendix A-6 to part 60 of this chapter.
- (2) EPA Method 320 in appendix A to part 63 of this chapter.
- (3) ASTM D6348-12 (Reapproved 2020) (incorporated by reference, see § 98.7).
- (4) EPA Method 25A in appendix A-7 to part 60 of this chapter, with the use of nonmethane cutter as described in § 1065.265 of this chapter.

[75 FR 74488, Nov. 30, 2010, as amended at 76 FR 22827, Apr. 25, 2011; 76 FR 59540, Sept. 27, 2011; 76 FR 80586, Dec. 23, 2011; 78 FR 25395, May 1, 2013; 79 FR 70410, Nov. 25, 2014; 80 FR 64291, Oct. 22, 2015; 81 FR 86514, Nov. 30, 2016; 89 FR 42287, May 14, 2024]

### § 98.235 Procedures for estimating missing data.

Except as specified in § 98.233, whenever a value of a parameter is unavailable for a GHG emission calculation required by this subpart (including, but not limited to, if a measuring device malfunctions during unit operation or activity data are not collected), you must follow the procedures specified in paragraphs (a) through (i) of this section, as applicable.

- (a) For stationary and portable combustion sources that use the calculation methods of subpart C of this part, you must use the missing data procedures in subpart C of this part.
- (b) For each missing value of a parameter that should have been measured quarterly or more frequently using equipment including, but not limited to, a continuous flow meter, composition analyzer, thermocouple, or pressure gauge, you must substitute the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If the “after” value is not obtained by the end of the reporting year, you may use the “before” value for the missing data substitution. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, you must use the first quality-assured value obtained after the missing data period as the substitute data value. A value is quality-assured according to the procedures specified in § 98.234.
- (c) For each missing value of a parameter that should have been measured annually, you must repeat the estimation or measurement activity for those sources as soon as possible, including in the subsequent calendar year if missing data are not discovered until after December 31 of the year in which data are collected, until valid data for reporting are obtained. Data developed and/or collected in a subsequent calendar year to substitute for missing data cannot be used for that subsequent year's emissions estimation. Where missing data procedures are used for the previous year, at least 30 days must separate emissions estimation or measurements for the previous year and emissions estimation or measurements for the current year of data collection.
- (d) For each missing value of a parameter that should have been measured biannually (every two years), you must conduct the estimation or measurement activity for those sources as soon as possible in the subsequent calendar year if the estimation or measurement was not made in the appropriate year (first year of data collection and every two years thereafter), until valid data for reporting are obtained. Data developed and/or collected in a subsequent calendar year to substitute for missing data cannot be used to alternate or postpone subsequent biannual emissions estimations or measurements.

- (e) For the first 6 months of required data collection, facilities that become newly subject to this subpart W may use best engineering estimates for any data that cannot reasonably be measured or obtained according to the requirements of this subpart.
- (f) For the first 6 months of required data collection, facilities that are currently subject to this subpart W and that start up new emission sources or acquire new sources from another facility that were not previously subject to this subpart W may use best engineering estimates for any data related to those newly operating or newly acquired sources that cannot reasonably be measured or obtained according to the requirements of this subpart.
- (g) Unless addressed in another paragraph of this section, for each missing value of any activity data, you must substitute data value(s) using the best available estimate(s) of the parameter(s), based on all applicable and available process or other data (including, but not limited to, processing rates, operating hours).
- (h) You must report information for all measured and substitute values of a parameter, and the procedures used to substitute an unavailable value of a parameter per the requirements in § 98.236(bb).
- (i) You must follow recordkeeping requirements listed in § 98.237(f).

[79 FR 70410, Nov. 25, 2014, as amended at 89 FR 42289, May 14, 2024]

## § 98.236 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain reported emissions and related information as specified in this section. Reporters that use a flow or volume measurement system that corrects to standard conditions as provided in the introductory text in § 98.233 for data elements that are otherwise required to be determined at actual conditions, report gas volumes at standard conditions rather than the gas volumes at actual conditions and report the standard temperature and pressure used by the measurement system rather than the actual temperature and pressure.

- (a) The annual report must include the information specified in paragraphs (a)(1) through (10) of this section for each applicable industry segment. The annual report must also include annual emissions totals, in metric tons of each GHG, for each applicable industry segment listed in paragraphs (a)(1) through (10) of this section, and each applicable emission source listed in paragraphs (b) through (z), (dd) and (ee) of this section.
  - (1) **Onshore petroleum and natural gas production.** For the equipment/activities specified in paragraphs (a)(1)(i) through (xxii) of this section, report the information specified in the applicable paragraphs of this section.
    - (i) **Natural gas pneumatic devices.** Report the information specified in paragraph (b) of this section.
    - (ii) **Natural gas driven pneumatic pumps.** Report the information specified in paragraph (c) of this section.
    - (iii) **Acid gas removal units and nitrogen removal units.** Report the information specified in paragraph (d) of this section.
    - (iv) **Dehydrators.** Report the information specified in paragraph (e) of this section.
    - (v) **Liquids unloading.** Report the information specified in paragraph (f) of this section.

- (vi) **Completions and workovers with hydraulic fracturing.** Report the information specified in paragraph (g) of this section.
- (vii) **Completions and workovers without hydraulic fracturing.** Report the information specified in paragraph (h) of this section.
- (viii) **Blowdown vent stacks.** Report the information specified in paragraph (i) of this section.
- (ix) **Hydrocarbon liquids and produced water storage tanks.** Report the information specified in paragraph (j) of this section.
- (x) **Well testing.** Report the information specified in paragraph (l) of this section.
- (xi) **Associated natural gas.** Report the information specified in paragraph (m) of this section.
- (xii) **Flare stacks.** Report the information specified in paragraph (n) of this section.
- (xiii) **Centrifugal compressors.** Report the information specified in paragraph (o) of this section.
- (xiv) **Reciprocating compressors.** Report the information specified in paragraph (p) of this section.
- (xv) **Equipment leak surveys.** Report the information specified in paragraph (q) of this section.
- (xvi) **Equipment leaks by population count.** Report the information specified in paragraph (r) of this section.
- (xvii) **EOR injection pumps.** Report the information specified in paragraph (w) of this section.
- (xviii) **EOR hydrocarbon liquids.** Report the information specified in paragraph (x) of this section.
- (xix) **Other large release events.** Report the information specified in paragraph (y) of this section.
- (xx) **Combustion equipment.** Report the information specified in paragraph (z) of this section.
- (xxi) **Drilling mud degassing.** Report the information specified in paragraph (dd) of this section.
- (xxii) **Crankcase vents.** Reporting the information specified in paragraph (ee) of this section.
- (2) **Offshore petroleum and natural gas production.** For the equipment/activities specified in paragraphs (a)(2)(i) and (ii) of this section, report the information specified in the applicable paragraphs of this section.
  - (i) **Offshore petroleum and natural gas production.** Report the information specified in paragraph (s) of this section.
  - (ii) **Other large release events.** Report the information specified in paragraph (y) of this section.
- (3) **Onshore natural gas processing.** For the equipment/activities specified in paragraphs (a)(3)(i) through (xi) of this section, report the information specified in the applicable paragraphs of this section.
  - (i) **Natural gas pneumatic devices.** Report the information specified in paragraph (b) of this section.
  - (ii) **Acid gas removal units and nitrogen removal units.** Report the information specified in paragraph (d) of this section.
  - (iii) **Dehydrators.** Report the information specified in paragraph (e) of this section.
  - (iv) **Blowdown vent stacks.** Report the information specified in paragraph (i) of this section.

- (v) *Hydrocarbon liquids and produced water storage tanks.* Report the information specified in paragraph (j) of this section.
  - (vi) *Flare stacks.* Report the information specified in paragraph (n) of this section.
  - (vii) *Centrifugal compressors.* Report the information specified in paragraph (o) of this section.
  - (viii) *Reciprocating compressors.* Report the information specified in paragraph (p) of this section.
  - (ix) *Equipment leak surveys.* Report the information specified in paragraph (q) of this section.
  - (x) *Other large release events.* Report the information specified in paragraph (y) of this section.
  - (xi) *Crankcase vents.* Report the information specified in paragraph (ee) of this section.
- (4) *Onshore natural gas transmission compression.* For the equipment/activities specified in paragraphs (a)(4)(i) through (x) of this section, report the information specified in the applicable paragraphs of this section.
- (i) *Natural gas pneumatic devices.* Report the information specified in paragraph (b) of this section.
  - (ii) *Dehydrators.* Report the information specified in paragraph (e) of this section.
  - (iii) *Blowdown vent stacks.* Report the information specified in paragraph (i) of this section.
  - (iv) *Condensate storage tanks.* Report the information specified in paragraph (k) of this section.
  - (v) *Flare stacks.* Report the information specified in paragraph (n) of this section.
  - (vi) *Centrifugal compressors.* Report the information specified in paragraph (o) of this section.
  - (vii) *Reciprocating compressors.* Report the information specified in paragraph (p) of this section.
  - (viii) *Equipment leak surveys.* Report the information specified in paragraph (q) of this section.
  - (ix) *Other large release events.* Report the information specified in paragraph (y) of this section.
  - (x) *Crankcase vents.* Reporting the information specified in paragraph (ee) of this section.
- (5) *Underground natural gas storage.* For the equipment/activities specified in paragraphs (a)(5)(i) through (xi) of this section, report the information specified in the applicable paragraphs of this section.
- (i) *Natural gas pneumatic devices.* Report the information specified in paragraph (b) of this section.
  - (ii) *Dehydrators.* Report the information specified in paragraph (e) of this section.
  - (iii) *Blowdown vent stacks.* Report the information specified in paragraph (i) of this section.
  - (iv) *Condensate storage tanks.* Report the information specified in paragraph (k) of this section.
  - (v) *Flare stacks.* Report the information specified in paragraph (n) of this section.
  - (vi) *Centrifugal compressors.* Report the information specified in paragraph (o) of this section.
  - (vii) *Reciprocating compressors.* Report the information specified in paragraph (p) of this section.
  - (viii) *Equipment leak surveys.* Report the information specified in paragraph (q) of this section.

- (ix) **Equipment leaks by population count.** Report the information specified in paragraph (r) of this section.
- (x) **Other large release events.** Report the information specified in paragraph (y) of this section.
- (xi) **Crankcase vents.** Reporting the information specified in paragraph (ee) of this section.
- (6) **LNG storage.** For the equipment/activities specified in paragraphs (a)(6)(i) through (ix) of this section, report the information specified in the applicable paragraphs of this section.
  - (i) **Acid gas removal units and nitrogen removal units.** Report the information specified in paragraph (d) of this section.
  - (ii) **Blowdown vent stacks.** Report the information specified in paragraph (i) of this section.
  - (iii) **Flare stacks.** Report the information specified in paragraph (n) of this section.
  - (iv) **Centrifugal compressors.** Report the information specified in paragraph (o) of this section.
  - (v) **Reciprocating compressors.** Report the information specified in paragraph (p) of this section.
  - (vi) **Equipment leak surveys.** Report the information specified in paragraph (q) of this section.
  - (vii) **Equipment leaks by population count.** Report the information specified in paragraph (r) of this section.
  - (viii) **Other large release events.** Report the information specified in paragraph (y) of this section.
  - (ix) **Crankcase vents.** Reporting the information specified in paragraph (ee) of this section.
- (7) **LNG import and export equipment.** For the equipment/activities specified in paragraphs (a)(7)(i) through (ix) of this section, report the information specified in the applicable paragraphs of this section.
  - (i) **Acid gas removal units and nitrogen removal units.** Report the information specified in paragraph (d) of this section.
  - (ii) **Blowdown vent stacks.** Report the information specified in paragraph (i) of this section.
  - (iii) **Flare stacks.** Report the information specified in paragraph (n) of this section.
  - (iv) **Centrifugal compressors.** Report the information specified in paragraph (o) of this section.
  - (v) **Reciprocating compressors.** Report the information specified in paragraph (p) of this section.
  - (vi) **Equipment leak surveys.** Report the information specified in paragraph (q) of this section.
  - (vii) **Equipment leaks by population count.** Report the information specified in paragraph (r) of this section.
  - (viii) **Other large release events.** Report the information specified in paragraph (y) of this section.
  - (ix) **Crankcase vents.** Reporting the information specified in paragraph (ee) of this section.
- (8) **Natural gas distribution.** For the equipment/activities specified in paragraphs (a)(8)(i) through (vii) of this section, report the information specified in the applicable paragraphs of this section.
  - (i) **Natural gas pneumatic devices.** Report the information specified in paragraph (b) of this section.
  - (ii) **Blowdown vent stacks.** Report the information specified in paragraph (i) of this section.

- (iii) *Equipment leak surveys.* Report the information specified in paragraph (q) of this section.
  - (iv) *Equipment leaks by population count.* Report the information specified in paragraph (r) of this section.
  - (v) *Other large release events.* Report the information specified in paragraph (y) of this section.
  - (vi) *Combustion equipment.* Report the information specified in paragraph (z) of this section.
  - (vii) *Crankcase vents.* Reporting the information specified in paragraph (ee) of this section.
- (9) *Onshore petroleum and natural gas gathering and boosting.* For the equipment/activities specified in paragraphs (a)(9)(i) through (xiv) of this section, report the information specified in the applicable paragraphs of this section.
- (i) *Natural gas pneumatic devices.* Report the information specified in paragraph (b) of this section.
  - (ii) *Natural gas driven pneumatic pumps.* Report the information specified in paragraph (c) of this section.
  - (iii) *Acid gas removal units and nitrogen removal units.* Report the information specified in paragraph (d) of this section.
  - (iv) *Dehydrators.* Report the information specified in paragraph (e) of this section.
  - (v) *Blowdown vent stacks.* Report the information specified in paragraph (i) of this section.
  - (vi) *Hydrocarbon liquids and produced water storage tanks.* Report the information specified in paragraph (j) of this section.
  - (vii) *Flare stacks.* Report the information specified in paragraph (n) of this section.
  - (viii) *Centrifugal compressors.* Report the information specified in paragraph (o) of this section.
  - (ix) *Reciprocating compressors.* Report the information specified in paragraph (p) of this section.
  - (x) *Equipment leak surveys.* Report the information specified in paragraph (q) of this section.
  - (xi) *Equipment leaks by population count.* Report the information specified in paragraph (r) of this section.
  - (xii) *Other large release events.* Report the information specified in paragraph (y) of this section.
  - (xiii) *Combustion equipment.* Report the information specified in paragraph (z) of this section.
  - (xiv) *Crankcase vents.* Reporting the information specified in paragraph (ee) of this section.
- (10) *Onshore natural gas transmission pipeline.* For the equipment/activities specified in paragraphs (a)(10)(i) through (iii) of this section, report the information specified in the applicable paragraphs of this section.
- (i) *Blowdown vent stacks.* Report the information specified in paragraph (i) of this section.
  - (ii) *Equipment leaks by population count.* Report the information specified in paragraph (r) of this section.
  - (iii) *Other large release events.* Report the information specified in paragraph (y) of this section.

- (b) **Natural gas pneumatic devices.** You must indicate whether the facility contains the following types of equipment: Continuous high bleed natural gas pneumatic devices, continuous low bleed natural gas pneumatic devices, and intermittent bleed natural gas pneumatic devices. If the facility contains any continuous high bleed natural gas pneumatic devices, continuous low bleed natural gas pneumatic devices, or intermittent bleed natural gas pneumatic devices, then you must report the information specified in paragraphs (b)(1) through (6) of this section, as applicable. You must report the information specified in paragraphs (b)(1) through (6) of this section, as applicable, for each well-pad site (for onshore petroleum and natural gas production), each gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments).
- (1) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (2) The number of natural gas pneumatic devices as specified in paragraphs (b)(2)(i) through (viii) of this section, as applicable. If a natural gas pneumatic device was vented directly to the atmosphere for part of the year and routed to a flare, combustion unit, or vapor recovery system during another part of the year, then include the device in each of the applicable counts specified in paragraphs (b)(2)(ii) through (vii) of this section.
    - (i) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed), determined according to § 98.233(a)(5) through (7).
    - (ii) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) vented directly to the atmosphere, determined according to § 98.233(a)(5) through (7).
    - (iii) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) routed to a flare, combustion, or vapor recovery system.
    - (iv) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) vented directly to the atmosphere for which emissions were calculated using Calculation Method 1 according to § 98.233(a)(1).
    - (v) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) vented directly to the atmosphere for which emissions were calculated using Calculation Method 2 according to § 98.233(a)(2).
    - (vi) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) vented directly to the atmosphere for which emissions were calculated using Calculation Method 3 according to § 98.233(a)(3).
    - (vii) The total number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) vented directly to the atmosphere for which emissions were calculated using Calculation Method 4 according to § 98.233(a)(4).
    - (viii) If the reported values in paragraphs (b)(2)(i) through (vii) of this section are estimated values determined according to § 98.233(a)(6), then you must report the information specified in paragraphs (b)(2)(viii)(A) through (C) of this section.

- (A) The number of natural gas pneumatic devices of each type reported in paragraphs (b)(2)(i) through (vii) of this section that are counted.
  - (B) The number of natural gas pneumatic devices of each type reported in paragraphs (b)(2)(i) through (vii) of this section that are estimated (not counted).
  - (C) Whether the calendar year is the first calendar year of reporting or the second calendar year of reporting.
- (3) For natural gas pneumatic devices vented directly to the atmosphere for which emissions were calculated using Calculation Method 1 according to § 98.233(a)(1), report the information in paragraphs (b)(3)(i) through (vi) of this section for each measurement location.
  - (i) Unique measurement location identification number.
  - (ii) Type of flow monitor (volumetric flow monitor; mass flow monitor).
  - (iii) Number of natural gas pneumatic devices of each type (continuous low bleed, continuous high bleed, and intermittent bleed) downstream of the flow monitor.
  - (iv) An indication of whether a natural gas driven pneumatic pump is also downstream of the flow monitor.
  - (v) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for the natural gas pneumatic devices calculated according to § 98.233(a)(1) for the measurement location.
  - (vi) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for the natural gas pneumatic devices calculated according to § 98.233(a)(1) for the measurement location.
- (4) For natural gas pneumatic devices vented directly to the atmosphere for which emissions were calculated using Calculation Method 2 according to § 98.233(a)(2), report the information in paragraphs (b)(4)(i) through (ii) of this section, as applicable.
  - (i) For onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting facilities:
    - (A) Indicate the primary measurement method used (temporary flow meter, calibrated bagging, or high volume sampler).
    - (B) The average number of hours each type of the natural gas pneumatic device (continuous low bleed, continuous high bleed, and intermittent bleed) was in service (*i.e.*, supplied with natural gas) in the calendar year.
    - (C) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, cumulative by type of natural gas pneumatic device for which emissions were directly measured and calculated as specified in § 98.233(a)(2)(iii) through (viii).
    - (D) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, cumulative by type of natural gas pneumatic device for which emissions were directly measured and calculated as specified in § 98.233(a)(2)(iii) through (viii).
  - (ii) For onshore natural gas processing facilities, onshore natural gas transmission compression facilities, underground natural gas storage facilities, and natural gas distribution facilities:
    - (A) The number of years used in the current measurement cycle.



- (B) Indicate the primary measurement method used (temporary flow meter, calibrated bagging, or high volume sampler) to measure the emissions from natural gas pneumatic devices at this facility.
  - (C) Indicate whether the emissions from any natural gas pneumatic devices at this facility were calculated using equation W-1B to § 98.233.
  - (D) If the emissions from any natural gas pneumatic devices at this facility were calculated using equation W-1B to § 98.233, report the following information for each type of natural gas pneumatic device (continuous low bleed, continuous high bleed, and intermittent bleed).
    - (1) The value of the emission factor for the reporting year as calculated using equation W-1A to § 98.233 (in scf/hour/device).
    - (2) The total number of natural gas pneumatic devices measured across all years upon which the emission factor is based (i.e., the cumulative value of " $\sum_{y=1}^n \text{Count}_{t,y}$ " in equation W-1A to § 98.233).
    - (3) Total number of natural gas pneumatic devices that vent directly to the atmosphere and that were not directly measured according to the requirements in § 98.233(a)(1) or (a)(2)(iii) (i.e., " $\text{Count}_t$ " in equation W-1B to § 98.233).
    - (4) The average estimated number of hours in the operating year the natural gas pneumatic devices were in service (i.e., supplied with natural gas) (" $T_t$ " in equation W-1B to § 98.233).
  - (E) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, cumulative by type of natural gas pneumatic device for which emissions were directly measured and calculated as specified in § 98.233(a)(2)(iii) through (viii).
  - (F) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, cumulative by type of natural gas pneumatic device for which emissions were directly measured and calculated as specified in § 98.233(a)(2)(iii) through (viii).
  - (G) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, cumulative by type of natural gas pneumatic device for which emissions were calculated according to § 98.233(a)(2)(ix). Enter 0 if all devices at this facility were monitored during the reporting year.
  - (H) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, cumulative by type of natural gas pneumatic device for which emissions were calculated according to § 98.233(a)(2)(ix). Enter 0 if all devices at this facility were monitored during the reporting year.
- (5) For natural gas pneumatic devices vented directly to the atmosphere for which emissions were calculated using Calculation Method 3 according to § 98.233(a)(3), report the information in paragraphs (b)(5)(i) through (iv) of this section.
- (i) For continuous high bleed and continuous low bleed natural gas pneumatic devices:
    - (A) Indicate whether you measured emissions according to § 98.233(a)(3)(i)(A) or used default emission factors according to § 98.233(a)(3)(i)(B) to calculate emissions from your continuous high bleed and continuous low bleed natural gas pneumatic devices vented directly to the atmosphere at this well-pad site, gathering and boosting site, or facility, as applicable.

- (B) If measurements were made according to § 98.233(a)(3)(i)(A), indicate the primary measurement method used (temporary flow meter, calibrated bagging, or high volume sampler).
- (C) If default emission factors were used according to § 98.233(a)(3)(i)(B) to calculate emissions, report the following information for each type of applicable natural gas pneumatic device (continuous low bleed and continuous high bleed).
  - (1) Total number of natural gas pneumatic devices that vent directly to the atmosphere and that were not directly measured according to the requirements in § 98.233(a)(1) or (a)(2)(iii) ("Count<sub>t</sub>" in equation W-1B to § 98.233).
  - (2) The average estimated number of hours in the operating year that the natural gas pneumatic devices were in service (i.e., supplied with natural gas) ("T<sub>t</sub>" in equation W-1B to § 98.233).
- (ii) For intermittent bleed natural gas pneumatic devices:
  - (A) Indicate the primary monitoring method used (OGI; Method 21 at 10,000 ppm; Method 21 at 500 ppm; or infrared laser beam) and the number of complete monitoring surveys conducted at the well-pad site or gathering and boosting site.
  - (B) The total number of intermittent bleed natural gas pneumatic devices detected as malfunctioning in any pneumatic device monitoring survey during the calendar year ("x" in equation W-1C to § 98.233).
  - (C) Average time the intermittent bleed natural gas pneumatic devices were in service (i.e., supplied with natural gas) and assumed to be malfunctioning in the calendar year (average value of "T<sub>mal,z</sub>" in equation W-1C to § 98.233).
  - (D) The total number of intermittent bleed natural gas pneumatic devices that were monitored but were not detected as malfunctioning in any pneumatic device monitoring survey during the calendar year ("Count" in equation W-1C to § 98.233).
  - (E) Average time the intermittent bleed natural gas pneumatic devices that were monitored but were not detected as malfunctioning in any pneumatic device monitoring survey during the calendar year were in service (i.e., supplied with natural gas) during the calendar year ("T<sub>avg</sub>" in equation W-1C to § 98.233).
- (iii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for each type of natural gas pneumatic device calculated according to Calculation Method 3 in § 98.233(a)(3).
- (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for each type of natural gas pneumatic device calculated according to Calculation Method 3 in § 98.233(a)(3).
- (6) For natural gas pneumatic devices vented directly to the atmosphere for which emissions were calculated using Calculation Method 4 according to § 98.233(a)(4), report the following information for each type of applicable natural gas pneumatic device (continuous low bleed, continuous high bleed, and intermittent bleed).
  - (i) Total number of natural gas pneumatic devices that vent directly to the atmosphere and that were not directly measured according to the requirements in § 98.233(a)(1) (i.e., "Count<sub>t</sub>" in equation W-1B to § 98.233).

- (ii) The average estimated number of hours in the operating year that the natural gas pneumatic devices were in service (*i.e.*, supplied with natural gas) (“ $T_t$ ” in equation W-1B to § 98.233).
- (iii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for each type of natural gas pneumatic device calculated according to Calculation Method 4 in § 98.233(a)(4).
- (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for each type of natural gas pneumatic device calculated according to Calculation Method 4 in § 98.233(a)(4).

(c) **Natural gas driven pneumatic pumps.** You must indicate whether the facility has any natural gas driven pneumatic pumps. If the facility contains any natural gas driven pneumatic pumps, then you must report the information specified in paragraphs (c)(1) through (5) of this section. You must report the information specified in paragraphs (c)(1) through (5) of this section, as applicable, for each well-pad site (for onshore petroleum and natural gas production) and each gathering and boosting site (for onshore petroleum and natural gas gathering and boosting).

- (1) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (2) The number of natural gas driven pneumatic pumps as specified in paragraphs (c)(2)(i) through (iv) of this section, as applicable. If a natural gas driven pneumatic pump was vented directly to the atmosphere for part of the year and routed to a flare, combustion, or vapor recovery system during another part of the year, then include the device in each of the applicable counts specified in paragraphs (c)(2)(ii) through (iv) of this section.
  - (i) The total number of natural gas driven pneumatic pumps.
  - (ii) The total number of natural gas driven pneumatic pumps vented directly to the atmosphere at any point during the year (including pumps that normally routed emissions to a flare but flow bypassed the flare for part of the year).
  - (iii) The total number of natural gas driven pneumatic pumps routed to a flare at any point during the year.
  - (iv) The total number of natural gas driven pneumatic pumps routed to combustion or a vapor recovery system at any point during the year.
- (3) For natural gas driven pneumatic pumps for which vented emissions were calculated using Calculation Method 1 according to § 98.233(c)(1), report the information in paragraphs (c)(3)(i) through (vi) of this section for each measurement location.
  - (i) Unique measurement location identification number.
  - (ii) Type of flow monitor (volumetric flow monitor; mass flow monitor).
  - (iii) Number of natural gas driven pneumatic pumps downstream of the flow monitor.
  - (iv) An indication of whether any natural gas pneumatic devices are also downstream of the monitoring location.
  - (v) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for the pneumatic pump(s) calculated according to § 98.233(c)(1) for the measurement location.

- (vi) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for the pneumatic pump(s) calculated according to § 98.233(c)(1) for the measurement location.
- (4) If you used Calculation Method 2 according to § 98.233(c)(2) to calculate vented emissions, report the information in paragraphs (c)(4)(i) through (ix) of this section, as applicable.
  - (i) The number of years used in the current measurement cycle.
  - (ii) The total number of natural gas driven pneumatic pumps for which emissions were measured or calculated using Calculation Method 2.
  - (iii) Indicate whether the emissions from the natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site, as applicable, were measured during the reporting year or if the emissions were calculated using equation W-2B to § 98.233.
  - (iv) If the natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site, as applicable, were measured during the reporting year, indicate the primary measurement method used (temporary flow meter, calibrated bagging, or high volume sampler).
  - (v) If the emissions from natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site, as applicable, were calculated using equation W-2B to § 98.233, report the following information:
    - (A) The value of the emission factor for the reporting year as calculated using equation W-2A to § 98.233 (in scf/hour/pump).
    - (B) The total number of natural gas driven pneumatic pumps measured across all years upon which the emission factor is based (i.e., the cumulative value of “ $\sum y=1^n \text{ Count}_y$ ” term used in equation W-2A to § 98.233).
    - (C) Total number of natural gas driven pneumatic pumps that vent directly to the atmosphere and that were not directly measured according to the requirements in § 98.233(c)(1) or (c)(2)(iii) (i.e., “Count” in equation W-2B to § 98.233).
    - (D) The average estimated number of hours in the operating year the pumps were pumping liquid (i.e., “T” in equation W-2B to § 98.233).
  - (vi) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, cumulative for all natural gas driven pneumatic pumps for which emissions were directly measured and calculated as specified in § 98.233(c)(2)(ii) through (vi). Enter 0 if emissions from none of the natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site were measured during the reporting year.
  - (vii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, cumulative for all natural gas driven pneumatic pumps for which emissions were directly measured and calculated as specified in § 98.233(c)(2)(ii) through (vi). Enter 0 if emissions from none of the natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site were measured during the reporting year.
  - (viii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, cumulative for all natural gas driven pneumatic pumps for which emissions were calculated according to § 98.233(c)(2)(vii)(B) through (D). Enter 0 if emissions from all natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site were measured during the reporting year.

- (ix) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, cumulative for all natural gas driven pneumatic pumps for which emissions were calculated according to § 98.233(c)(2)(vii)(B) through (D). Enter 0 if emissions from all natural gas driven pneumatic pumps at this well-pad site or gathering and boosting site were measured during the reporting year.
- (5) If you used Calculation Method 3 according to § 98.233(c)(3) to calculate vented emissions, report the information in paragraphs (c)(5)(i) through (iv) of this section for the natural gas driven pneumatic pumps subject to Calculation Method 3.
  - (i) Number of pumps that vent directly to the atmosphere (i.e., "Count" in equation W-2B to § 98.233).
  - (ii) Average estimated number of hours in the calendar year that natural gas driven pneumatic pumps that vented directly to atmosphere were pumping liquid ("T" in equation W-2B to § 98.233).
  - (iii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for all natural gas driven pneumatic pumps vented directly to the atmosphere combined, calculated according to § 98.233(c)(3).
  - (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for all natural gas driven pneumatic pumps vented directly to the atmosphere combined, calculated according to § 98.233(c)(3).
- (d) **Acid gas removal units and nitrogen removal units.** You must indicate whether your facility has any acid gas removal units or nitrogen removal units that vent directly to the atmosphere, to a flare or engine, or to a sulfur recovery plant. For any acid gas removal units or nitrogen removal units that vent directly to the atmosphere or to a sulfur recovery plant, you must report the information specified in paragraphs (d)(1) and (2) of this section. If the acid gas removal units or nitrogen removal units that vent directly to the atmosphere for only part of the year, report the information specified in paragraph (d)(2) if this section for the part of the year that the units vent directly to the atmosphere. For acid gas removal units or nitrogen removal units that were routed to an engine or routed to a vapor recovery system for the entire year, you must only report the information specified in paragraphs (d)(1)(i) through (v) and (x) of this section. For acid gas removal units or nitrogen removal units that were routed to flares for which you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), you must report the information specified in paragraphs (d)(1)(i) through (v) and (x) of this section, as applicable. For acid gas removal units that were routed to flares for which you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(d) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (d)(1)(i) through (vii) and (x) of this section and paragraph (d)(2) of this section.
- (1) You must report the information specified in paragraphs (d)(1)(i) through (xi) of this section for each acid gas removal unit or nitrogen removal unit, as applicable.
  - (i) A unique name or ID number for the acid gas removal unit or nitrogen removal unit. For the onshore petroleum and natural gas production and the onshore petroleum and natural gas gathering and boosting industry segments, a different name or ID may be used for a single acid gas removal unit or nitrogen removal unit for each location it operates at in a given year.
  - (ii) Whether the acid gas removal unit or nitrogen removal unit vent was routed to a flare. If so, report the information specified in paragraphs (d)(1)(ii)(A) through (D) of this section for acid gas removal units and the information specified in paragraph (d)(1)(ii)(B) of this section for nitrogen removal units.

- (A) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(d) as specified in § 98.233(n)(3)(ii)(B).
- (B) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
- (C) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section to which the acid gas removal unit or nitrogen removal unit vent was routed.
- (D) The unique ID for the stream routed to the flare as specified in paragraph (n)(3) of this section from the acid gas removal unit or nitrogen removal unit vent.
- (iii) Whether the acid gas removal unit or nitrogen removal unit vent was routed to combustion, and if so, whether it was routed for the entire year or only part of the year.
- (iv) Whether the acid gas removal unit or nitrogen removal unit vent was routed to a vapor recovery system, and if so, whether it was routed for the entire year or only part of the year.
- (v) Total feed rate entering the acid gas removal unit or nitrogen removal unit, using a meter or engineering estimate based on process knowledge or best available data, in million standard cubic feet per year.
- (vi) If the acid gas removal unit or nitrogen removal unit was routed to a flare, to combustion, or to vapor recovery for only part of the year, the feed rate entering the acid gas removal unit or nitrogen removal unit during the portion of the year that the emissions were vented directly to the atmosphere, using a meter or engineering estimate based on process knowledge or best available data, in million standard cubic feet per year.
- (vii) The calculation method used to calculate CO<sub>2</sub> and CH<sub>4</sub> emissions from the acid gas removal unit or to calculate CH<sub>4</sub> emissions from the nitrogen removal unit, as specified in § 98.233(d).
- (viii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, vented directly to the atmosphere from the acid gas removal unit, calculated using any one of the calculation methods specified in § 98.233(d) and as specified in § 98.233(d)(11) and (12).
- (ix) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, vented directly to the atmosphere from the acid gas removal unit or nitrogen removal unit, calculated using any one of the calculation methods specified in § 98.233(d) and as specified in § 98.233(d)(11) and (12).
- (x) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (2) You must report information specified in paragraphs (d)(2)(i) through (iii) of this section, applicable to the calculation method reported in paragraph (d)(1)(iii) of this section, for each acid gas removal unit or nitrogen removal unit.

- (i) If you used Calculation Method 1 or Calculation Method 2 as specified in § 98.233(d) to calculate CO<sub>2</sub> emissions from the acid gas removal unit and Calculation Method 2 as specified in § 98.233(d) to calculate CH<sub>4</sub> emissions from the acid gas removal unit or nitrogen removal unit, then you must report the information specified in paragraphs (d)(2)(i)(A) through (C) of this section, as applicable.
  - (A) Annual average volumetric fraction of CO<sub>2</sub> in the vent gas exiting the acid gas removal unit.
  - (B) Annual average volumetric fraction of CH<sub>4</sub> in the vent gas exiting the acid gas removal unit or nitrogen removal unit.
  - (C) Annual volume of gas vented from the acid gas removal unit or nitrogen removal unit, in cubic feet.
  - (D) The temperature that corresponds to the reported annual volume of gas vented from the unit, in degrees Fahrenheit. If the annual volume of gas vented is reported in actual cubic feet, report the actual temperature; if it is reported in standard cubic feet, report 60 °F.
  - (E) The pressure that corresponds to the reported annual volume of gas vented from the unit, in pounds per square inch absolute. If the annual volume of gas vented is reported in actual cubic feet, report the actual pressure; if it is reported in standard cubic feet, report 14.7 psia.
- (ii) If you used Calculation Method 3 as specified in § 98.233(d) to calculate CO<sub>2</sub> or CH<sub>4</sub> emissions from the acid gas removal unit or nitrogen removal unit, then you must report the information specified in paragraphs (d)(2)(ii)(A) through (M) of this section, as applicable depending on the equation used.
  - (A) Indicate which equation was used (equation W-4A, W-4B, or W-4C to § 98.233).
  - (B) Annual average volumetric fraction of CO<sub>2</sub> in the natural gas flowing out of the acid gas removal unit, as specified in equation W-4A, equation W-4B, or equation W-4C to § 98.233.
  - (C) Annual average volumetric fraction of CO<sub>2</sub> content in natural gas flowing into the acid gas removal unit, as specified in equation W-4A, equation W-4B, or equation W-4C to § 98.233.
  - (D) Annual average volumetric fraction of CO<sub>2</sub> in the vent gas exiting the acid gas removal unit, as specified in equation W-4A or equation W-4B to § 98.233.
  - (E) Annual average volumetric fraction of CH<sub>4</sub> in the natural gas flowing out of the acid gas removal unit or nitrogen removal unit, as specified in equation W-4A, equation W-4B, or equation W-4C to § 98.233.
  - (F) Annual average volumetric fraction of CH<sub>4</sub> content in natural gas flowing into the acid gas removal unit or nitrogen removal unit, as specified in equation W-4A, equation W-4B, or equation W-4C to § 98.233.
  - (G) Annual average volumetric fraction of CH<sub>4</sub> in the vent gas exiting the acid gas removal unit or nitrogen removal unit, as specified in equation W-4A or equation W-4B to § 98.233.
  - (H) The total annual volume of natural gas flow into the acid gas removal unit or nitrogen removal unit, as specified in equation W-4A or equation W-4C to § 98.233, in cubic feet at actual conditions.

- (I) The temperature that corresponds to the reported total annual volume of natural gas flow into the acid gas removal unit or nitrogen removal unit, as specified in equation W-4A or equation W-4C to § 98.233, in degrees Fahrenheit. If the total annual volume of natural gas flow is reported in actual cubic feet, report the actual temperature; if it is reported in standard cubic feet, report 60 °F.
- (J) The pressure that corresponds to the reported total annual volume of natural gas flow into the acid gas removal unit or nitrogen removal unit, as specified in equation W-4A or equation W-4C to § 98.233, in pounds per square inch absolute. If the total annual volume of natural gas flow is reported in actual cubic feet, report the actual pressure; if it is reported in standard cubic feet, report 14.7 psia.
- (K) The total annual volume of natural gas flow out of the acid gas removal unit or nitrogen removal unit, as specified in equation W-4B or equation W-4C to § 98.233, in cubic feet at actual conditions.
- (L) The temperature that corresponds to the reported total annual volume of natural gas flow out of the acid gas removal unit or nitrogen removal unit, as specified in equation W-4B or equation W-4C to § 98.233, in degrees Fahrenheit. If the total annual volume of natural gas flow is reported in actual cubic feet, report the actual temperature; if it is reported in standard cubic feet, report 60 °F.
- (M) The pressure that corresponds to the reported total annual volume of natural gas flow out of the acid gas removal unit or nitrogen removal unit, as specified in equation W-4B or equation W-4C to § 98.233, in pounds per square inch absolute. If the total annual volume of natural gas flow is reported in actual cubic feet, report the actual pressure; if it is reported in standard cubic feet, report 14.7 psia.
- (iii) If you used Calculation Method 4 as specified in § 98.233(d) to calculate CO<sub>2</sub> or CH<sub>4</sub> emissions from the acid gas removal unit or nitrogen removal unit, then you must report the information specified in paragraphs (d)(2)(iii)(A) through (O) of this section, as applicable to the simulation software package used.
  - (A) The name of the simulation software package used.
  - (B) Annual average natural gas feed temperature, in degrees Fahrenheit.
  - (C) Annual average natural gas feed pressure, in pounds per square inch.
  - (D) Annual average natural gas feed flow rate, in standard cubic feet per minute.
  - (E) Annual average acid gas content of the feed natural gas, in mole percent.
  - (F) Annual average acid gas content of the outlet natural gas, in mole percent.
  - (G) Annual average methane content of the feed natural gas, in mole percent.
  - (H) Annual average methane content of the outlet natural gas, in mole percent.
  - (I) Total annual unit operating hours, excluding downtime for maintenance or standby, in hours per year.
  - (J) Annual average exit temperature of the natural gas, in degrees Fahrenheit.
  - (K) Annual average solvent pressure, in pounds per square inch.



- (L) Annual average solvent temperature, in degrees Fahrenheit.
- (M) Annual average solvent circulation rate, in gallons per minute.
- (N) Solvent type used for the majority of the year, from one of the following options: Selexol<sup>TM</sup>, Rectisol®, Purisol<sup>TM</sup>, Fluor Solvent<sup>SM</sup>, Benfield<sup>TM</sup>, 20 wt% MEA, 30 wt% MEA, 40 wt% MDEA, 50 wt% MDEA, and other (specify).
- (O) If a vent meter is installed and you elected to use Calculation Method 4 for an AGR, report the information in paragraphs (d)(2)(iii)(O)(1) through (3) of this section.
  - (1) The total annual volume of vent gas flowing out of the AGR in cubic feet per year at actual conditions as determined by flow meter ( $V_{a, \text{meter}}$  from equation W-4D to § 98.233).
  - (2) The total annual volume of vent gas flowing out of the AGR in cubic feet per year at actual conditions as determined the standard simulation software package ( $V_{a, \text{sim}}$  from equation W-4D to § 98.233).
  - (3) If the calculated percent difference between the vent volumes ("PD" from equation W-4D to § 98.233) is greater than 20 percent, provide a brief description of the reason for the difference.
- (e) **Dehydrators.** You must indicate whether your facility contains any of the following equipment: Glycol dehydrators for which you calculated emissions using Calculation Method 1 according to § 98.233(e)(1), glycol dehydrators for which you calculated emissions using Calculation Method 2 according to § 98.233(e)(2), and dehydrators that use desiccant. If your facility contains any of the equipment listed in this paragraph (e), then you must report the applicable information in paragraphs (e)(1) through (3) of this section. For dehydrators that were routed to flares for which you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), you must report the information specified in paragraph (e)(4) of this section. For dehydrators that were routed to flares for which you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(e) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the applicable information in paragraphs (e)(1) through (3) of this section and the information specified in paragraph (e)(4) of this section.
  - (1) For each glycol dehydrator for which you calculated emissions using Calculation Method 1 (as specified in § 98.233(e)(1)), you must report the information specified in paragraphs (e)(1)(i) through (xviii) of this section for the dehydrator. If reported emissions are based on more than one simulation, you must report the average of the simulation inputs.
    - (i) A unique name or ID number for the dehydrator. For the onshore petroleum and natural gas production and the onshore petroleum and natural gas gathering and boosting industry segments, a different name or ID may be used for a single dehydrator for each location it operates at in a given year.
    - (ii) Dehydrator feed natural gas flow rate, in million standard cubic feet per day.
    - (iii) Dehydrator feed natural gas water content, in pounds per million standard cubic feet.
    - (iv) Dehydrator outlet natural gas water content, in pounds per million standard cubic feet.

- (v) Dehydrator absorbent circulation pump type (e.g., natural gas pneumatic, air pneumatic, or electric).
- (vi) Dehydrator absorbent circulation rate, in gallons per minute.
- (vii) Type of absorbent (e.g., triethylene glycol (TEG), diethylene glycol (DEG), or ethylene glycol (EG)).
- (viii) Whether stripping gas is used in dehydrator.
- (ix) Whether a flash tank separator is used in dehydrator.
- (x) Total time the dehydrator is operating during the year, in hours.
- (xi) Temperature of the wet natural gas at the absorber inlet, in degrees Fahrenheit.
- (xii) Pressure of the wet natural gas at the absorber inlet, in pounds per square inch gauge.
- (xiii) Mole fraction of CH<sub>4</sub> in wet natural gas.
- (xiv) Mole fraction of CO<sub>2</sub> in wet natural gas.
- (xv) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (xvi) If a flash tank separator is used in the dehydrator, then you must report the information specified in paragraphs (e)(1)(xvi)(A) through (F) of this section for the emissions from the flash tank vent, as applicable. If flash tank emissions were routed to a regenerator firebox/fire tubes, then you must also report the information specified in paragraphs (e)(1)(xvi)(G) through (I) of this section for the combusted emissions from the flash tank vent.
  - (A) Whether any flash gas emissions are vented directly to the atmosphere, routed to a flare, routed to the regenerator firebox/fire tubes, routed to a vapor recovery system, used as stripping gas, or any combination.
  - (B) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from the flash tank when not routed to a flare or regenerator firebox/fire tubes, calculated according to § 98.233(e)(1) and, if applicable, (e)(4).
  - (C) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from the flash tank when not routed to a flare or regenerator firebox/fire tubes, calculated according to § 98.233(e)(1) and, if applicable, (e)(4).
  - (D) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from routing flash gas to a regenerator firebox/fire tubes, calculated according to § 98.233(e)(5).
  - (E) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from routing flash gas to a regenerator firebox/fire tubes, calculated according to § 98.233(e)(5).
  - (F) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O, that resulted from routing flash gas to a regenerator firebox/fire tubes, calculated according to § 98.233(e)(5).
  - (G) Indicate whether the regenerator firebox/fire tubes was monitored with a CEMS. If a CEMS was used, then paragraphs (e)(1)(xvi)(E) and (F) and (e)(1)(xvi)(H) and (I) of this section do not apply.

- (H) Total volume of gas from the flash tank to a regenerator firebox/fire tubes, in standard cubic feet.
- (I) Average combustion efficiency, expressed as a fraction of gas from the flash tank combusted by a burning regenerator firebox/fire tubes.
- (xvii) Report the information specified in paragraphs (e)(1)(xvii)(A) through (F) of this section for the emissions from the still vent, as applicable. If still vent emissions were routed to a regenerator firebox/fire tubes, then you must also report the information specified in paragraphs (e)(1)(xvii)(G) through (I) of this section for the combusted emissions from the still vent.
  - (A) Whether any still vent emissions are vented directly to the atmosphere, routed to a flare, routed to the regenerator firebox/fire tubes, routed to a vapor recovery system, used as stripping gas, or any combination.
  - (B) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from the still vent when not routed to a flare or regenerator firebox/fire tubes, calculated according to § 98.233(e)(1), and, if applicable, (e)(4).
  - (C) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from the still vent when not routed to a flare or regenerator firebox/fire tubes, calculated according to § 98.233(e)(1) and, if applicable, (e)(4).
  - (D) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from routing still vent gas to a regenerator firebox/fire tubes, calculated according to § 98.233(e)(5).
  - (E) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from routing still vent gas to a regenerator firebox/fire tubes, calculated according to § 98.233(e)(5).
  - (F) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O, that resulted from routing still vent gas to a regenerator firebox/fire tubes, calculated according to § 98.233(e)(5).
  - (G) Indicate whether the regenerator firebox/fire tubes were monitored with a CEMS. If a CEMS was used, then paragraphs (e)(1)(xvii)(E) and (F) and (e)(1)(xvii)(H) and (I) of this section do not apply.
  - (H) Total volume of gas from the still vent to a regenerator firebox/fire tubes, in standard cubic feet.
  - (I) Average combustion efficiency, expressed as a fraction of gas from the still vent combusted by a burning regenerator firebox/fire tubes.
- (xviii) Name of the software package used.
- (2) You must report the information specified in paragraphs (e)(2)(i) through (vi) of this section for all glycol dehydrators with an annual average daily natural gas throughput greater than 0 million standard cubic feet per day and less than 0.4 million standard cubic feet per day for which you calculated emissions using Calculation Method 2 (as specified in § 98.233(e)(2)) at the facility, well-pad site, or gathering and boosting site.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).

- (ii) The total number of dehydrators at the facility, well-pad site, or gathering and boosting site for which you calculated emissions using Calculation Method 2.
- (iii) Whether any dehydrator emissions were routed to a vapor recovery system. If any dehydrator emissions were routed to a vapor recovery system, then you must report the total number of dehydrators at the facility that routed to a vapor recovery system.
- (iv) Whether any dehydrator emissions were routed to a control device that reduces CO<sub>2</sub> and/or CH<sub>4</sub> emissions other than a vapor recovery system or a flare or regenerator firebox/fire tubes. If any dehydrator emissions were routed to a control device that reduces CO<sub>2</sub> and/or CH<sub>4</sub> emissions other than a vapor recovery system or a flare or regenerator firebox/fire tubes, then you must specify the type of control device(s) and the total number of dehydrators at the facility that were routed to each type of control device.
- (v) Whether any dehydrator emissions were routed to a flare or regenerator firebox/fire tubes. If any dehydrator emissions were routed to a flare or regenerator firebox/fire tubes, then you must report the information specified in paragraphs (e)(2)(v)(A) through (E) of this section.
  - (A) The total number of dehydrators routed to a flare and the total number of dehydrators routed to regenerator firebox/fire tubes.
  - (B) Total volume of gas from the flash tank to a regenerator firebox/fire tubes, in standard cubic feet.
  - (C) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for the dehydrators routed to a regenerator firebox/fire tubes reported in paragraph (e)(2)(v)(A) of this section, calculated according to § 98.233(e)(5).
  - (D) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for the dehydrators routed to a regenerator firebox/fire tubes reported in paragraph (e)(2)(v)(A) of this section, calculated according to § 98.233(e)(5).
  - (E) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O, for the dehydrators routed to a regenerator firebox/fire tubes reported in paragraph (e)(2)(v)(A) of this section, calculated according to § 98.233(e)(5).
- (vi) For dehydrator emissions that were not routed to a flare or regenerator firebox/fire tubes, report the information specified in paragraphs (e)(2)(vi)(A) and (B) of this section.
  - (A) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for emissions from all dehydrators reported in paragraph (e)(2)(ii) of this section that were not routed to a flare or regenerator firebox/fire tubes, calculated according to § 98.233(e)(2) and, if applicable, (e)(4), where emissions are added together for all such dehydrators.
  - (B) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for emissions from all dehydrators reported in paragraph (e)(2)(ii) of this section that were not routed to a flare or regenerator firebox/fire tubes, calculated according to § 98.233(e)(2) and, if applicable, (e)(4), where emissions are added together for all such dehydrators.
- (3) For dehydrators that use desiccant (as specified in § 98.233(e)(3)), you must report the information specified in paragraphs (e)(3)(i) through (viii) of this section for each well-pad site, gathering and boosting site, or facility, as applicable.

- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (ii) Count of desiccant dehydrators as specified in paragraphs (e)(3)(ii)(A) and (B) of this section that had one or more openings during the calendar year at the facility, well-pad site, or gathering and boosting site for which you calculated emissions using Calculation Method 3.
  - (A) The number of opened desiccant dehydrators that used deliquescent desiccant (e.g., calcium chloride or lithium chloride).
  - (B) The number of opened desiccant dehydrators that used regenerative desiccant (e.g., molecular sieves, activated alumina, or silica gel).
- (iii) For desiccant dehydrators at the facility, well-pad site, or gathering and boosting site identified in paragraph (e)(3)(ii) of this section, total physical volume of all opened dehydrator vessels.
- (iv) For desiccant dehydrators at the facility, well-pad site, or gathering and boosting site identified in paragraph (e)(3)(ii) of this section, total number of dehydrator openings in the calendar year.
- (v) For desiccant dehydrators at the facility, well-pad site, or gathering and boosting site identified in paragraph (e)(3)(ii) of this section, whether any dehydrator emissions were routed to a vapor recovery system. If any dehydrator emissions were routed to a vapor recovery system, then you must report the total number of dehydrators at the facility that routed to a vapor recovery system.
- (vi) For desiccant dehydrators at the facility, well-pad site, or gathering and boosting site identified in paragraph (e)(3)(ii) of this section, whether any dehydrator emissions were routed to a control device that reduces CO<sub>2</sub> and/or CH<sub>4</sub> emissions other than a vapor recovery system or a flare or a non-flare combustion unit. If any dehydrator emissions were routed to a control device that reduces CO<sub>2</sub> and/or CH<sub>4</sub> emissions other than a vapor recovery system or a flare or a non-flare combustion unit, then you must specify the type of control device(s) and the total number of dehydrators at the facility that were routed to each type of control device.
- (vii) For desiccant dehydrators at the facility, well-pad site, or gathering and boosting site identified in paragraph (e)(3)(ii) of this section, whether any dehydrator emissions were routed to a flare or a non-flare combustion unit. If any dehydrator emissions were routed to a flare or a non-flare combustion unit, then you must report the information specified in paragraphs (e)(3)(vii)(A) through (E) of this section.
  - (A) The total number of dehydrators routed to a flare and the total number of dehydrators routed to a non-flare combustion unit.
  - (B) Total volume of gas routed to non-flare combustion units, in standard cubic feet.
  - (C) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for the dehydrators routed to non-flare combustion units reported in paragraph (e)(3)(vii)(A) of this section, calculated according to § 98.233(e)(5).
  - (D) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for the dehydrators routed to non-flare combustion units reported in paragraph (e)(3)(vii)(A) of this section, calculated according to § 98.233(e)(5).

- (E) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O, for the dehydrators routed to non-flare combustion units reported in paragraph (e)(3)(vii)(A) of this section, calculated according to § 98.233(e)(5).
- (viii) For desiccant dehydrators at the facility, well-pad site, or gathering and boosting site identified in paragraph (e)(3)(ii) of this section that were not routed to a flare or a non-flare combustion unit, report the information specified in paragraphs (e)(3)(viii)(A) and (B) of this section.
  - (A) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for emissions from all desiccant dehydrators reported under paragraph (e)(3)(ii) of this section that are not venting to a flare or non-flare combustion unit, calculated according to § 98.233(e)(3) and, if applicable, (e)(4), and summing for all such dehydrators.
  - (B) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for emissions from all desiccant dehydrators reported in paragraph (e)(3)(ii) of this section that are not venting to a flare or non-flare combustion unit, calculated according to § 98.233(e)(3), and, if applicable, (e)(4), and summing for all such dehydrators.
- (4) For dehydrators that were routed to flares, report the information specified in paragraphs (e)(4)(i) through (iv) of this section.
  - (i) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(e) as specified in § 98.233(n)(3)(ii)(B).
  - (ii) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (iii) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section to which the dehydrator vent was routed.
  - (iv) The unique ID for the stream routed to the flare as specified in paragraph (n)(3) of this section from the dehydrator.
- (f) **Liquids unloading.** You must indicate whether well venting for liquids unloading occurs at your facility, and if so, which methods (as specified in § 98.233(f)) were used to calculate emissions. If your facility performs well venting for liquids unloading venting to the atmosphere and uses Calculation Method 1, then you must report the information specified in paragraph (f)(1) of this section. If the facility performs liquids unloading venting to the atmosphere and uses Calculation Method 2 or 3, then you must report the information specified in paragraph (f)(2) of this section.
  - (1) For each well for which you used Calculation Method 1 to calculate natural gas emissions from well venting for liquids unloading vented to the atmosphere, report the information specified in paragraphs (f)(1)(i) through (xii) of this section. Report information separately for wells with plunger lifts and wells without plunger lifts by unloading type combination (with or without plunger lifts, automated or manual unloading).
    - (i) Well ID number.
    - (ii) Well tubing diameter and pressure group ID.
    - (iii) Unloading type combination (with or without plunger lifts, automated or manual unloading).

- (iv) [Reserved]
- (v) Indicate whether the monitoring period used to determine the cumulative amount of time venting to the atmosphere was not the full calendar year.
- (vi) Cumulative amount of time the well was vented directly to the atmosphere (“ $T_p$ ” from equation W-7A or W-7B to § 98.233), in hours.
- (vii) Cumulative number of unloadings vented directly to the atmosphere for the well.
- (viii) Annual natural gas emissions, in standard cubic feet, from well venting for liquids unloading, calculated according to § 98.233(f)(1).
- (ix) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from well venting for liquids unloading, calculated according to § 98.233(f)(1) and (4).
- (x) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from well venting for liquids unloading, calculated according to § 98.233(f)(1) and (4).
- (xi) For each well tubing diameter group and pressure group combination, you must report the information specified in paragraphs (f)(1)(xi)(A) through (F) of this section for each individual well not using a plunger lift that was tested during the year.
  - (A) Well ID number of tested well.
  - (B) Casing pressure, in pounds per square inch absolute.
  - (C) Internal casing diameter, in inches.
  - (D) Measured depth of the well, in feet.
  - (E) Average flow rate of the well venting over the duration of the liquids unloading, in standard cubic feet per hour.
  - (F) Unloading type (automated or manual).
- (xii) For each well tubing diameter group and pressure group combination, you must report the information specified in paragraphs (f)(1)(xii)(A) through (F) of this section for each individual well using a plunger lift that was tested during the year.
  - (A) Well ID number.
  - (B) The tubing pressure, in pounds per square inch absolute.
  - (C) The internal tubing diameter, in inches.
  - (D) Measured depth of the well, in feet.
  - (E) Average flow rate of the well venting over the duration of the liquids unloading, in standard cubic feet per hour.
  - (F) Unloading type (automated or manual).
- (2) For each well for which you used Calculation Method 2 or 3 (as specified in § 93.233(f)) to calculate natural gas emissions from well venting for liquids unloading vented to the atmosphere, you must report the information in paragraphs (f)(2)(i) through (xii) of this section. Report information separately for each calculation method and unloading type combination (with or without plunger lifts, automated or manual unloadings).

- (i) Well ID number.
- (ii) Calculation method.
- (iii) Unloading type combination (with or without plunger lifts, automated or manual unloadings).
- (iv) [Reserved]
- (v) Cumulative number of unloadings venting directly to the atmosphere for the well.
- (vi) Annual natural gas emissions, in standard cubic feet, from well venting for liquids unloading, calculated according to § 98.233(f)(2) or (3), as applicable.
- (vii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from well venting for liquids unloading, calculated according to § 98.233(f)(2) or (3), as applicable, and § 98.233(f)(4).
- (viii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from well venting for liquids unloading, calculated according to § 98.233(f)(2) or (3), as applicable, and § 98.233(f)(4).
- (ix) Average flow-line rate of gas (average of “SFR<sub>p</sub>” from equation W-8 or W-9 to § 98.233, as applicable), at standard conditions in cubic feet per hour.
- (x) Cumulative amount of time that wells were left open to the atmosphere during unloading events (sum of “HR<sub>p,q</sub>” from equation W-8 or W-9 to § 98.233, as applicable), in hours.
- (xi) For each well without plunger lifts, the information in paragraphs (f)(2)(xi)(A) through (C) of this section.
  - (A) Internal casing diameter (“CD<sub>p</sub>” from equation W-8 to § 98.233), in inches.
  - (B) Well depth (“WD<sub>p</sub>” from equation W-8 to § 98.233), in feet.
  - (C) Shut-in pressure, surface pressure, or casing pressure (“SP<sub>p</sub>” from equation W-8 to § 98.233), in pounds per square inch absolute.
- (xii) For each well with plunger lifts, the information in paragraphs (f)(2)(xiii)(A) through (C) of this section.
  - (A) Internal tubing diameter (“TD<sub>p</sub>” from equation W-9 to § 98.233), in inches.
  - (B) Tubing depth (“WD<sub>p</sub>” from equation W-9 to § 98.233), in feet.
  - (C) Flow line pressure (“SP<sub>p</sub>” from equation W-9 to § 98.233), in pounds per square inch absolute.

(g) **Completions and workovers with hydraulic fracturing.** You must indicate whether your facility had any well completions or workovers with hydraulic fracturing during the calendar year. If your facility had well completions or workovers with hydraulic fracturing during the calendar year that vented directly to the atmosphere, then you must report information specified in paragraphs (g)(1) through (10) of this section, for each well. If your facility had well completions or workovers with hydraulic fracturing during the year that routed to flares and you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), then you must report the information specified in paragraphs (g)(1) through (3) and (10) of this section, for each well. If your facility had well completions or workovers with hydraulic fracturing during the year that routed to flares and you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(g) to



determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (g)(1) through (6) and (10) of this section, for each well. Report information separately for completions and workovers.

- (1) Well ID number.
- (2) Well type combination (horizontal or vertical, flared or vented, reduced emission completion or not a reduced emission completion, gas well or oil well).
- (3) Number of completions or workovers for each well.
- (4) Calculation method used.
- (5) If you used equation W-10A to § 98.233 to calculate annual volumetric total gas emissions, then you must report the information specified in paragraphs (g)(5)(i) through (v) of this section.
  - (i) Cumulative gas flowback time, in hours, for all completions or workovers at the well from when gas is first detected until sufficient quantities are present to enable separation, and the cumulative flowback time, in hours, after sufficient quantities of gas are present to enable separation (sum of “ $T_{p,i}$ ” and sum of “ $T_{p,s}$ ” values used in equation W-10A to § 98.233). You may delay the reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total number of hours of flowback from the well during completions or workovers.
  - (ii) If the well is a measured well for the sub-basin and well-type combination, the flowback rate, in standard cubic feet per hour (average of “ $FR_{s,p}$ ” values used in equation W-12A to § 98.233). You may delay the reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured flowback rate(s) during well completion or workover for the well.
  - (iii) If you used equation W-12C to § 98.233 to calculate the average gas production rate for an oil well, then you must report the information specified in paragraphs (g)(5)(iii)(A) and (B) of this section.
    - (A) Gas to oil ratio for the well in standard cubic feet of gas per barrel of oil (“ $GOR_p$ ” in equation W-12C to § 98.233). You may delay the reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the gas to oil ratio for the well.
    - (B) Volume of oil produced during the first 30 days of production after completion of the newly drilled well or well workover using hydraulic fracturing, in barrels (“ $V_p$ ” in equation W-12C to § 98.233). You may delay the reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the volume of oil produced during the first 30 days of production after well completion or workover for the well.
  - (iv) Whether the flow rate during the initial flowback period was determined using:

- (A) A recording flow meter (digital or analog) installed on the vent line, downstream of a separator.
  - (B) A multiphase flow meter upstream of the separator.
  - (C) Equation W-11A or W-11B to § 98.233.
- (v) Whether the flow rate when sufficient quantities are present to enable separation was determined using:
  - (A) A recording flow meter (digital or analog) installed on the vent line, downstream of a separator.
  - (B) Equation W-11A or W-11B to § 98.233.
- (6) If you used equation W-10B to § 98.233 to calculate annual volumetric total gas emissions, then you must report the information specified in paragraphs (g)(6)(i) through (iii) of this section.
  - (i) Vented natural gas volume, in standard cubic feet ("FV<sub>s,p</sub>" in equation W-10B to § 98.233).
  - (ii) Flow rate at the beginning of the period of time when sufficient quantities of gas are present to enable separation, in standard cubic feet per hour ("FR<sub>p,i</sub>" in equation W-10B to § 98.233).
  - (iii) If a multiphase flowmeter was used to measure the flow rate during the initial flowback period, report the average flow rate measured by the multiphase flow meter from the initiation of flowback to the beginning of the period of time when sufficient quantities of gas present to enable separation in standard cubic feet per hour.
- (7) Annual gas emissions, in standard cubic feet ("E<sub>s,n</sub>" in equation W-10A or W-10B to § 98.233).
- (8) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>.
- (9) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>.
- (10) Indicate whether natural gas emissions from completion(s) or workover(s) with hydraulic fracturing were routed to a flare and emissions are reported according to paragraph (n) of this section, and if so, provide the information specified in paragraphs (g)(10)(i) through (iv) of this section.
  - (i) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(g) as specified in § 98.233(n)(3)(ii)(B).
  - (ii) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (iii) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section.
  - (iv) The unique ID for each stream routed to the flare as specified in paragraph (n)(3) of this section.

- (h) **Completions and workovers without hydraulic fracturing.** You must indicate whether the facility had any gas well completions without hydraulic fracturing or any gas well workovers without hydraulic fracturing, and if the activities occurred with or without flaring. If the facility had gas well completions or workovers without hydraulic fracturing, then you must report the information specified in paragraphs (h)(1) through (4) of this section, as applicable.
- (1) For each well with one or more gas well completions without hydraulic fracturing and without flaring, report the information specified in paragraphs (h)(1)(i) through (vi) of this section.
- (i) Well ID number.
  - (ii) Number of well completions that vented gas directly to the atmosphere without flaring.
  - (iii) Total number of hours that gas vented directly to the atmosphere during venting for all completions without hydraulic fracturing (“ $T_p$ ” for completions that vented directly to the atmosphere as used in equation W-13B to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total number of hours that gas vented directly to the atmosphere during completions for the well.
  - (iv) Average daily gas production rate for all completions without hydraulic fracturing without flaring, in standard cubic feet per hour (“ $V_p$ ” in equation W-13B to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured average daily gas production rate during completions for the well.
  - (v) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from completions venting gas directly to the atmosphere (“ $E_{s,p}$ ” from equation W-13B to § 98.233 for completions that vented directly to the atmosphere, converted to mass emissions according to § 98.233(h)(1)).
  - (vi) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from completions venting gas directly to the atmosphere (“ $E_{s,p}$ ” from equation W-13B to § 98.233 for completions that vented directly to the atmosphere, converted to mass emissions according to § 98.233(h)(1)).
- (2) If your facility had well completions without hydraulic fracturing and with flaring during the year and you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), then you must report the information specified in paragraphs (h)(2)(i) through (ii) and (viii) of this section, for each well. If your facility had well completions without hydraulic fracturing during the year that routed to flares and you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(h) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (h)(2)(i) through (iv) and (viii) of this section, for each well.
- (i) Well ID number.
  - (ii) Number of well completions that flared gas.
  - (iii) Total number of hours that gas routed to a flare during venting for all completions without hydraulic fracturing (“ $T_p$ ” for completions that vented to a flare from equation W-13B to § 98.233). You may delay reporting of this data element if you indicate in the annual report that

the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total number of hours that gas vented to the flare during completions for the well.

- (iv) Average daily gas production rate for all completions without hydraulic fracturing with flaring, in standard cubic feet per hour (“ $V_p$ ” from equation W-13B to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured average daily gas production rate during completions for the well.
- (v) [Reserved]
- (vi) [Reserved]
- (vii) [Reserved]
- (viii) Report the information specified in paragraphs (h)(2)(viii)(A) through (D).
  - (A) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(h) as specified in § 98.233(n)(3)(ii)(B).
  - (B) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (C) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section.
  - (D) The unique ID for each stream routed to the flare as specified in paragraph (n)(3) of this section.
- (3) For each well with one or more gas well workovers without hydraulic fracturing and without flaring, report the information specified in paragraphs (h)(3)(i) through (iv) of this section.
  - (i) Well ID number.
  - (ii) Number of workovers that vented gas to the atmosphere without flaring.
  - (iii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub> per year, that resulted from workovers venting gas directly to the atmosphere (“ $E_{s,wo}$ ” in equation W-13A to § 98.233 for workovers that vented directly to the atmosphere, converted to mass emissions as specified in § 98.233(h)(1)).
  - (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub> per year, that resulted from workovers venting gas directly to the atmosphere (“ $E_{s,wo}$ ” in equation W-13A to § 98.233 for workovers that vented directly to the atmosphere, converted to mass emissions as specified in § 98.233(h)(1)).
- (4) If your facility had well workovers without hydraulic fracturing and with flaring during the year and you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), then you must report the information specified in paragraphs (h)(4)(i) through (ii) and (vi) of this section, for each well. If your facility had well workovers without hydraulic fracturing during the year that routed to flares and you calculated

natural gas emissions routed to the flare using the calculation methods in § 98.233(h) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (h)(4)(i) through (ii) and (vi) of this section, for each well.

(i) Well ID number.

(ii) Number of workovers that flared gas.

(iii)-(v) [Reserved]

(vi) Report the information specified in paragraphs (h)(4)(vi)(A) through (D).

(A) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(h) as specified in § 98.233(n)(3)(ii)(B).

(B) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.

(C) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section.

(D) The unique ID for each stream routed to the flare as specified in paragraph (n)(3) of this section.

(i) **Blowdown vent stacks.** You must indicate whether your facility has blowdown vent stacks. If your facility has blowdown vent stacks, then you must report whether emissions were calculated by equipment or event type or by using flow meters or a combination of both. If you calculated emissions by equipment or event type for any blowdown vent stacks, then you must report the information specified in paragraph (i)(1) of this section considering, in aggregate, all blowdown vent stacks for which emissions were calculated by equipment or event type. If you calculated emissions using flow meters for any blowdown vent stacks, then you must report the information specified in paragraph (i)(2) of this section considering, in aggregate, all blowdown vent stacks for which emissions were calculated using flow meters. For the onshore natural gas transmission pipeline segment, you must also report the information in paragraph (i)(3) of this section. You must report the information specified in paragraphs (i)(1) through (3) of this section, as applicable, for each well-pad site (for onshore production), each gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments).

(1) **Report by equipment or event type.** If you calculated emissions from blowdown vent stacks by the seven categories listed in § 98.233(i)(2)(iv)(A) for onshore petroleum and natural gas production, onshore natural gas processing, onshore natural gas transmission compression, underground natural gas storage, LNG storage, LNG import and export equipment, or onshore petroleum and natural gas gathering and boosting industry segments, then you must report the information specified in paragraphs (i)(1)(i) through (v) of this section, as applicable. If a blowdown event resulted in emissions from multiple equipment or event types, and the emissions cannot be apportioned to the different equipment or event types, then you may report the information in paragraphs (i)(1)(ii) through (v) of this section for the equipment or event type that represented the largest portion of the emissions for the blowdown event. For the onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting industry segments, if a blowdown event is not directly associated with a specific well-pad site or gathering and boosting site

(e.g., a mid-field pipeline blowdown) or could be associated with multiple well-pad or gathering and boosting sites, then you may report the information in paragraphs (i)(1)(i) through (v) of this section for either the nearest well-pad site or gathering and boosting site upstream from the blowdown event or the well-pad site or gathering and boosting site that represented the largest portion of the emissions for the blowdown event, as appropriate. If you calculated emissions from blowdown vent stacks by the eight categories listed in § 98.233(i)(2)(iv)(B) for the natural gas distribution or onshore natural gas transmission pipeline industry segments, then you must report the information specified in paragraphs (i)(1)(ii) through (v) of this section, as applicable. If a blowdown event resulted in emissions from multiple equipment or event types, and the emissions cannot be apportioned to the different equipment or event types, then you may report the information in paragraphs (i)(1)(ii) through (v) of this section for the equipment or event type that represented the largest portion of the emissions for the blowdown event.

- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (ii) Equipment or event type. For the onshore petroleum and natural gas production, onshore natural gas processing, onshore natural gas transmission compression, underground natural gas storage, LNG storage, LNG import and export equipment, or onshore petroleum and natural gas gathering and boosting industry segments, use the seven categories listed in § 98.233(i)(2)(iv)(A). For the natural gas distribution or onshore natural gas transmission pipeline industry segments, use the eight categories listed in § 98.233(i)(2)(iv)(B).
- (iii) Total number of blowdowns in the calendar year for the equipment or event type (the sum of equation variable “N” from equation W-14A or equation W-14B to § 98.233, for all unique physical volumes for the equipment or event type).
- (iv) Annual CO<sub>2</sub> emissions for the equipment or event type, in metric tons CO<sub>2</sub>, calculated according to § 98.233(i)(2)(iii).
- (v) Annual CH<sub>4</sub> emissions for the equipment or event type, in metric tons CH<sub>4</sub>, calculated according to § 98.233(i)(2)(iii).

- (2) **Report by flow meter.** If you elect to calculate emissions from blowdown vent stacks by using a flow meter according to § 98.233(i)(3), then you must report the information specified in paragraphs (i)(2)(i) through (iii) of this section, as applicable. For the onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting industry segments, if a blowdown event is not directly associated with a specific well-pad site or gathering and boosting site (e.g., a mid-field pipeline blowdown) or could be associated with multiple well-pad sites or gathering and boosting sites, then you may report the information in paragraphs (i)(2)(i) through (iii) of this section for either the nearest well-pad site or gathering and boosting site upstream from the blowdown event or the well-pad site or gathering and boosting site that represented the largest portion of the emissions for the blowdown event, as appropriate.

- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).

- (ii) Annual CO<sub>2</sub> emissions from all blowdown vent stacks at the facility, well-pad site, or gathering and boosting site for which emissions were calculated using flow meters, in metric tons CO<sub>2</sub> (the sum of all CO<sub>2</sub> mass emission values calculated according to § 98.233(i)(3), for all flow meters).
- (iii) Annual CH<sub>4</sub> emissions from all blowdown vent stacks at the facility, well-pad site, or gathering and boosting site for which emissions were calculated using flow meters, in metric tons CH<sub>4</sub>, (the sum of all CH<sub>4</sub> mass emission values calculated according to § 98.233(i)(3), for all flow meters).

(3) **Onshore natural gas transmission pipeline segment.** Report the information in paragraphs (i)(3)(i) through (iii) of this section for each state.

- (i) Annual CO<sub>2</sub> emissions in metric tons CO<sub>2</sub>.
- (ii) Annual CH<sub>4</sub> emissions in metric tons CH<sub>4</sub>.
- (iii) Annual number of blowdown events.

(j) **Hydrocarbon liquids and produced water storage tanks.** You must indicate whether your facility sends hydrocarbon produced liquids and/or produced water to atmospheric pressure storage tanks. If your facility sends hydrocarbon produced liquids and/or produced water to atmospheric pressure storage tanks, then you must indicate which Calculation Method(s) you used to calculate GHG emissions, and you must report the information specified in paragraphs (j)(1) and (2) of this section, as applicable. If you used Calculation Method 1 or Calculation Method 2 of § 98.233(j), and any atmospheric pressure storage tanks were observed to have malfunctioning dump valves during the calendar year, then you must indicate that dump valves were malfunctioning and must report the information specified in paragraph (j)(3) of this section. For hydrocarbon liquids and produced water storage tanks that were routed to flares for which you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and (ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), you must report the information specified in paragraph (j)(4) of this section. For hydrocarbon liquids and produced water storage tanks that were routed to flares for which you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(j) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the applicable information in paragraphs (j)(1) through (3) of this section and the information specified in paragraph (j)(4) of this section.

(1) If you used Calculation Method 1 or Calculation Method 2 of § 98.233(j) to calculate GHG emissions, then you must report the information specified in paragraphs (j)(1)(i) through (xvi) of this section for each well-pad site (for onshore petroleum and natural gas production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments) and by calculation method and liquid type, as applicable. Onshore petroleum and natural gas gathering and boosting and onshore natural gas processing facilities do not report the information specified in paragraph (j)(1)(ix) of this section.

- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (ii) Calculation method used, and name of the software package used if using Calculation Method 1.

- (iii) The total annual hydrocarbon liquids or produced water volume from gas-liquid separators and direct from wells or non-separator equipment that is sent to applicable atmospheric pressure storage tanks, in barrels. You may delay reporting of this data element for onshore production if you indicate in the annual report that wildcat wells and/or delineation wells are the only wells at the well-pad site with hydrocarbon liquids or produced water production flowing to gas-liquid separators or direct to atmospheric pressure storage tanks for which you used the same calculation method. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total volume of hydrocarbon liquids or produced water from all wells and the well ID number(s) for the well(s) included in this volume.
- (iv) The average well, gas-liquid separator, or non-separator equipment temperature, in degrees Fahrenheit.
- (v) The average well, gas-liquid separator, or non-separator equipment pressure, in pounds per square inch gauge.
- (vi) For atmospheric pressure storage tanks receiving hydrocarbon liquids, the average sales oil or stabilized hydrocarbon liquids API gravity, in degrees.
- (vii) If you used Calculation Method 1 of § 98.233(j) to calculate GHG emissions for atmospheric pressure storage tanks receiving hydrocarbon liquids, the flow-weighted average concentration (mole fraction) of CO<sub>2</sub> in flash gas from atmospheric pressure storage tanks (calculated as the sum of all products of the concentration of CO<sub>2</sub> in the flash gas for each storage tank times the total quantity of flash gas for that storage tank, divided by the sum of all flash gas emissions from storage tanks).
- (viii) If you used Calculation Method 1 of § 98.233(j) to calculate GHG emissions for atmospheric pressure storage tanks receiving hydrocarbon liquids, the flow-weighted average concentration (mole fraction) of CH<sub>4</sub> in flash gas from atmospheric pressure storage tanks (calculated as the sum of all products of the concentration of CH<sub>4</sub> in the flash gas for each storage tank times the total quantity of flash gas for that storage tank, divided by the sum of all flash gas emissions from storage tanks).
- (ix) The number of wells sending hydrocarbon liquids or produced water to gas-liquid separators or directly to atmospheric pressure storage tanks.
- (x) Count of atmospheric pressure storage tanks specified in paragraphs (j)(1)(x)(A) through (F) of this section.
  - (A) The number of fixed roof atmospheric pressure storage tanks.
  - (B) The number of floating roof atmospheric pressure storage tanks.
  - (C) The number of atmospheric pressure storage tanks that vented gas directly to the atmosphere and did not control emissions using a vapor recovery system or one or more flares at any point during the reporting year.
  - (D) The number of atmospheric pressure storage tanks that routed emissions to a vapor recovery system at any point during the reporting year.
  - (E) The number of atmospheric pressure storage tanks that routed emissions to one or more flares at any point during the reporting year.



- (F) The number of atmospheric pressure storage tanks in paragraph (j)(1)(x)(D) or (E) of this section that had an open thief hatch at some point during the year while the storage tank was also routing emissions to a vapor recovery system and/or a flare.
  - (xi) For atmospheric pressure storage tanks receiving hydrocarbon liquids, annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from venting gas directly to the atmosphere, calculated according to § 98.233(j)(1) and (2).
  - (xii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from venting gas directly to the atmosphere, calculated according to § 98.233(j)(1) and (2).
  - (xiii) For the atmospheric pressure storage tanks receiving hydrocarbon liquids identified in paragraphs (j)(1)(x)(D) of this section, total CO<sub>2</sub> mass, in metric tons CO<sub>2</sub>, that was recovered during the calendar year using a vapor recovery system.
  - (xiv) For the atmospheric pressure storage tanks identified in paragraphs (j)(1)(x)(D) of this section, total CH<sub>4</sub> mass, in metric tons CH<sub>4</sub>, that was recovered during the calendar year using a vapor recovery system.
  - (xv) For the atmospheric pressure storage tanks identified in paragraph (j)(1)(x)(F) of this section, the total volume of gas vented through open thief hatches, in scf, during periods while the storage tanks were also routing emissions to vapor recovery systems and/or flares.
- (2) If you used Calculation Method 3 to calculate GHG emissions, then you must report the information specified in paragraphs (j)(2)(i) through (iii) of this section.
- (i) Report the information specified in paragraphs (j)(2)(i)(A) through (H) of this section, at the facility level, for atmospheric pressure storage tanks where emissions were calculated using Calculation Method 3 of § 98.233(j).
    - (A) The total annual hydrocarbon liquids throughput that is sent to all atmospheric pressure storage tanks in the facility with emissions calculated using Calculation Method 3, in barrels. You may delay reporting of this data element for onshore production if you indicate in the annual report that wildcat wells and/or delineation wells are the only wells at the facility with hydrocarbon liquids production that send hydrocarbon liquids to atmospheric pressure storage tanks for which emissions were calculated using Calculation Method 3. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total annual hydrocarbon liquids throughput from all wells and the well ID number(s) for the well(s) included in this volume.
    - (B) The total annual produced water throughput that is sent to all atmospheric pressure storage tanks in the facility with emissions calculated using Calculation Method 3, in barrels, specified in paragraphs (j)(2)(i)(B)(1) through (3) of this section.
      - (1) Total volume of produced water with pressure less than or equal to 50 psi.
      - (2) Total volume of produced water with pressure greater than 50 psi and less than or equal to 250 psi.
      - (3) Total volume of produced water with pressure greater than 250 psi.
    - (C) An estimate of the fraction of hydrocarbon liquids throughput reported in paragraph (j)(2)(i)(A) of this section sent to atmospheric pressure storage tanks in the facility that controlled emissions with flares.

- (D) An estimate of the fraction of hydrocarbon liquids throughput reported in paragraph (j)(2)(i)(A) of this section sent to atmospheric pressure storage tanks in the facility that controlled emissions with vapor recovery systems.
- (E) An estimate of the fraction of total produced water throughput reported in paragraph (j)(2)(i)(B) of this section sent to atmospheric pressure storage tanks in the facility that controlled emissions with flares.
- (F) An estimate of the fraction of total produced water throughput reported in paragraph (j)(2)(i)(B) of this section sent to atmospheric pressure storage tanks in the facility that controlled emissions with vapor recovery systems.
- (G) The number of fixed roof atmospheric pressure storage tanks in the facility.
- (H) The number of floating roof atmospheric pressure storage tanks in the facility.
- (ii) Report the information specified in paragraphs (j)(2)(ii)(A) through (H) of this section for each well-pad site (for onshore production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments) with atmospheric pressure storage tanks receiving hydrocarbon liquids whose emissions were calculated using § 98.233(j)(3)(i).
  - (A) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (B) The number of atmospheric pressure storage tanks that did not control emissions with flares and for which emissions were calculated using Calculation Method 3.
  - (C) The number of atmospheric pressure storage tanks that controlled emissions with flares and for which emissions were calculated using Calculation Method 3.
  - (D) The number of atmospheric pressure storage tanks that had an open thief hatch at some point during the year while the storage tank was also routing emissions to a vapor recovery system and/or a flare.
  - (E) The total number of separators, wells, or non-separator equipment with annual average daily hydrocarbon liquids throughput greater than 0 barrels per day and less than 10 barrels per day for which you used Calculation Method 3 ("Count" from equation W-15A to § 98.233).
  - (F) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from venting gas directly to the atmosphere, calculated using equation W-15A to § 98.233 and adjusted using the requirements described in § 98.233(j)(4), if applicable.
  - (G) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from venting gas directly to the atmosphere, calculated using equation W-15A to § 98.233 and adjusted using the requirements described in § 98.233(j)(4), if applicable.
  - (H) The total volume of gas vented through open thief hatches, in scf, during periods while the atmospheric pressure storage tanks were also routing emissions to vapor recovery systems and/or flares.

- (iii) Report the information specified in paragraphs (j)(2)(iii)(A) through (F) of this section for each well-pad site (for onshore production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for onshore natural gas processing) with atmospheric pressure storage tanks receiving produced water whose emissions were calculated using § 98.233(j)(3)(ii).
  - (A) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (B) The number of atmospheric pressure storage tanks that did not control emissions with flares and for which emissions were calculated using Calculation Method 3.
  - (C) The number of atmospheric pressure storage tanks that controlled emissions with flares and for which emissions were calculated using Calculation Method 3.
  - (D) The number of atmospheric pressure storage tanks that had an open thief hatch at some point during the year while the storage tank was also routing emissions to a vapor recovery system and/or a flare.
  - (E) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from venting gas directly to the atmosphere, calculated using equation W-15B to § 98.233 and adjusted using the requirements described in § 98.233(j)(4), if applicable.
  - (F) The total volume of gas vented through open thief hatches, in scf, during periods while the atmospheric pressure storage tanks were also routing emissions to vapor recovery systems and/or flares.
- (3) If you used Calculation Method 1 or Calculation Method 2 of § 98.233(j), and any gas-liquid separator liquid dump values did not close properly during the calendar year, then you must report the information specified in paragraphs (j)(3)(i) through (v) of this section for each well-pad site (for onshore production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments) by liquid type.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) The total number of gas-liquid separators whose liquid dump valves did not close properly during the calendar year.
  - (iii) The total time the dump valves on gas-liquid separators did not close properly in the calendar year, in hours (sum of the “T<sub>dv</sub>” values used in equation W-16 to § 98.233).
  - (iv) For atmospheric pressure storage tanks receiving hydrocarbon liquids, annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from dump valves on gas-liquid separators not closing properly during the calendar year, calculated using equation W-16 to § 98.233.
  - (v) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from the dump valves on gas-liquid separators not closing properly during the calendar year, calculated using equation W-16 to § 98.233.
- (4) For atmospheric pressure storage tanks that were routed to flares, report the information specified in paragraphs (j)(4)(i) through (iv) of this section.

- (i) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(j) as specified in § 98.233(n)(3)(ii)(B).
  - (ii) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (iii) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section to which the atmospheric pressure storage tank vent was routed.
  - (iv) The unique ID for the stream routed to the flare as specified in paragraph (n)(3) of this section from the atmospheric pressure storage tank.
- (k) Condensate storage tanks. You must indicate whether your facility contains any condensate storage tanks. If your facility contains at least one condensate storage tank, then you must report the information specified in paragraphs (k)(1) and (2) of this section for each condensate storage tank vent stack.
- (1) For each condensate storage tank vent stack, report the information specified in (k)(1)(i) through (iv) of this section.
- (i) The unique name or ID number for the condensate storage tank vent stack.
  - (ii) Indicate if a flare is attached to the condensate storage tank vent stack.
  - (iii) Indicate whether scrubber dump valve leakage occurred for the condensate storage tank vent according to § 98.233(k)(1).
  - (iv) Which method specified in § 98.233(k)(1) was used to determine if dump valve leakage occurred.
- (2) If scrubber dump valve leakage occurred for a condensate storage tank vent stack, as reported in paragraph (k)(1)(iii) of this section, and the vent stack vented directly to the atmosphere during the calendar year, then you must report the information specified in paragraphs (k)(2)(i) through (v) of this section for each condensate storage vent stack where scrubber dump valve leakage occurred.
- (i) Which method specified in § 98.233(k)(2) was used to measure the leak rate.
  - (ii) Measured leak rate (average leak rate from a continuous flow measurement device), in standard cubic feet per hour.
  - (iii) Duration of time that the leak is counted as having occurred, in hours, as determined in § 98.233(k)(3) (may use best available data if a continuous flow measurement device was used).
  - (iv) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, that resulted from venting gas directly to the atmosphere, calculated according to § 98.233(k)(1) through (4).
  - (v) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, that resulted from venting gas directly to the atmosphere, calculated according to § 98.233(k)(1) through (4).
- (l) **Well testing.** You must indicate whether you performed gas well or oil well testing, and if the testing of gas wells or oil wells resulted in vented or flared emissions during the calendar year. If you performed well testing that resulted in vented or flared emissions during the calendar year, then you must report the information specified in paragraphs (l)(1) through (4) of this section, as applicable.

- (1) For oil wells not routed to a flare, you must report the information specified in paragraphs (l)(1)(i) through (vii) of this section for each well tested.
  - (i) [Reserved]
  - (ii) Well ID number.
  - (iii) Number of well testing days for the tested well in the calendar year.
  - (iv) Average gas to oil ratio for the tested well, in cubic feet of gas per barrel of oil. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the average gas to oil ratio for the tested well.
  - (v) Average flow rate for the tested well, in barrels of oil per day. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured average flow rate for the tested well.
  - (vi) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, calculated according to § 98.233(l).
  - (vii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, calculated according to § 98.233(l).
- (2) For oil wells routed to a flare and where you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), then you must report the information specified in paragraphs (l)(2)(i) through (ii) and (ix) of this section, for each well tested. For oil wells routed to a flare and where you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(l) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (l)(2)(i) through (v) and (ix) of this section. All reported data elements should be specific to the well for which equation W-17A to § 98.233 was used and for which well testing emissions were routed to flares.
  - (i) [Reserved]
  - (ii) Well ID number.
  - (iii) Number of well testing days for the tested well in the calendar year.
  - (iv) Average gas to oil ratio for the tested well, in cubic feet of gas per barrel of oil. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the average gas to oil ratio for the tested well.
  - (v) Average flow rate for the tested well, in barrels of oil per day. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured average flow rate for the tested well.
  - (vi)-(viii) [Reserved]
  - (ix) Indicate whether natural gas emissions from well testing were routed to a flare and emissions are reported according to paragraph (n) of this section, and if so, provide the information specified in paragraphs (l)(2)(ix)(A) through (D).

- (A) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(l) as specified in § 98.233(n)(3)(ii)(B).
  - (B) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (C) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section.
  - (D) The unique ID for each stream routed to the flare as specified in paragraph (n)(3) of this section.
- (3) For gas wells not routed to a flare, you must report the information specified in paragraphs (l)(3)(i) through (vi) of this section for each well tested.
- (i) [Reserved]
  - (ii) Well ID number.
  - (iii) Number of well testing days for the tested well in the calendar year. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the number of well testing days for the tested well.
  - (iv) Average annual production rate for the tested well, in actual cubic feet per day. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured average annual production rate for the tested well.
  - (v) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, calculated according to § 98.233(l).
  - (vi) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, calculated according to § 98.233(l).
- (4) For gas wells routed to a flare and where you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), then you must report the information specified in paragraphs (l)(4)(i) through (ii) and (viii) of this section, for each well tested. For gas wells routed to a flare and where you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(l) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (l)(4)(i) through (iv) and (viii) of this section for each well tested. All reported data elements should be specific to the well for which equation W-17B to § 98.233 was used and for which well testing emissions were routed to flares.
- (i) [Reserved]
  - (ii) Well ID number.

- (iii) Number of well testing days for the tested well in the calendar year. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the number of well testing days for the tested well.
- (iv) Average annual production rate for the tested well, in actual cubic feet per day. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured average annual production rate for the tested well.
- (v)-(vii) [Reserved]
- (viii) Indicate whether natural gas emissions from well testing were routed to a flare and emissions are reported according to paragraph (n) of this section, and if so, provide the information specified in paragraphs (l)(4)(viii)(A) through (D).
  - (A) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(l) as specified in § 98.233(n)(3)(ii)(B).
  - (B) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (C) The unique name or ID for the flare stack as specified in paragraph (n)(1) of this section.
  - (D) The unique ID for each stream routed to the flare as specified in paragraph (n)(3) of this section.
- (m) Associated natural gas. You must indicate whether any associated gas was vented or flared during the calendar year. If associated gas was vented during the calendar year, then you must report the information specified in paragraphs (m)(1) through (7) of this section for each well for which associated gas was vented. If associated gas was flared during the calendar year and you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), then you must report the information specified in paragraphs (m)(1) through (3) of this section, for each well. If associated gas was flared and you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(m) to determine natural gas volumes as specified in § 98.233(n)(3)(ii)(B), then you must report the information specified in paragraphs (m)(1) through (6) of this section for each well.
  - (1) Well ID number.
  - (2) Indicate whether any associated gas was vented directly to the atmosphere without flaring.
  - (3) Indicate whether any associated gas was flared and emissions are reported according to paragraph (n) of this section, and, if so, provide the information specified in paragraphs (m)(3)(i) through (iv).

- (i) Indicate whether you calculated natural gas emissions routed to the flare using continuous parameter monitoring systems as specified in § 98.233(n)(3)(i) and 98.233(n)(3)(ii)(A) and continuous gas composition analyzers or sampling as specified in § 98.233(n)(4), or you calculated natural gas emissions routed to the flare using the calculation methods in § 98.233(m) as specified in § 98.233(n)(3)(ii)(B).
  - (ii) Indicate whether natural gas emissions were routed to a flare for the entire year or only part of the year.
  - (iii) The unique name or ID for the flare stack to which associated natural gas is routed as specified in paragraph (n)(1) of this section.
  - (iv) The unique ID for each associated natural gas stream routed to the flare as specified in paragraph (n)(3) of this section.
- (4) Average gas to oil ratio, in standard cubic feet of gas per barrel of oil during the reporting year. Do not report the GOR if you vented or flared associated gas and used a continuous flow monitor to determine the total volume of associated gas vented or routed to the flare (i.e., if you did not use equation W-18 to § 98.233 for the well with associated gas venting or flaring emissions).
- (5) Volume of oil produced by the well, in barrels, in the calendar year only during the time periods in which associated gas was vented or flared ("V<sub>p</sub>" used in equation W-18 to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the volume of oil produced by the well during the time periods in which associated gas venting and flaring was occurring. Do not report the volume of oil produced if you vented or flared associated gas and used a continuous flow monitor to determine the total volume of associated gas vented or routed to the flare (i.e., if you did not use equation W-18 to § 98.233 for the well with associated gas venting or flaring emissions).
- (6) Total volume of associated gas sent to sales or used on site and not sent to a vent or flare, in standard cubic feet, in the calendar year only during time periods in which associated gas was vented or flared ("SG" value used in equation W-18 to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured total volume of associated gas sent to sales for the well during the time periods in which associated gas venting and flaring was occurring. Do not report the volume of gas sent to sales if you vented or flared associated gas and used a continuous flow monitor to determine the total volume of associated gas vented or routed to the flare (i.e., if you did not use equation W-18 to § 98.233).
- (7) If you had associated gas emissions vented directly to the atmosphere without flaring, then you must report the information specified in paragraphs (m)(7)(i) through (viii) of this section for each well.
- (i) [Reserved]
  - (ii) Indicate whether the associated gas volume vented from the well was measured using a continuous flow monitor.
  - (iii) Indicate whether associated gas streams vented from the well were measured with a continuous gas composition analyzer.
  - (iv) Total volume of associated gas vented from the well, in standard cubic feet.



- (v) Flow-weighted average mole fraction of CH<sub>4</sub> in associated gas vented from the well.
  - (vi) Flow-weighted average mole fraction of CO<sub>2</sub> in associated gas vented from the well.
  - (vii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, calculated according to § 98.233(m)(3) and (4).
  - (viii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, calculated according to § 98.233(m)(3) and (4).
- (n) **Flare stacks.** You must indicate if your facility has any flare stacks. You must report the information specified in paragraphs (n)(1) through (20) of this section for each flare stack at your facility.
- (1) Unique name or ID for the flare stack. For the onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting industry segments, a different name or ID may be used for a single flare stack for each location where it operates at in a given calendar year.
  - (2) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (3) Unique IDs for each stream routed to the flare and the source type that generated the stream, if you determine the flow of each stream that is routed to the flare as specified in § 98.233(n)(3)(ii) and/or you determine the gas composition for each stream routed to the flare as specified in § 98.233(n)(4)(iii). If you determine flow or composition for a combined stream from multiple source types, then report the source type that provides the most gas to the combined stream. For source types not listed in § 98.233(n)(3)(ii)(B)(1) through (7), report collectively as “other.”
  - (4) Indicate the type of flare (*i.e.*, open ground-level flare, enclosed ground-level flare, open elevated flare, or enclosed elevated flare).
  - (5) Indicate the type of flare assist (*i.e.*, unassisted, air-assisted with single speed fan/blower, air-assisted with dual speed fan/blower, air-assisted with variable speed fan/blower, steam-assisted, or pressure-assisted).
  - (6) Indicate whether the pilot flame or combustion flame was monitored continuously, visually inspected, or both. If visually inspected, report the number of inspections during the year. If the pilot flame was monitored continuously, report the number of times all continuous monitoring devices were out of service or otherwise inoperable for a period of more than one week.
  - (7) Indicate whether you measured total flow at the inlet to the flare as specified in § 98.233(n)(3)(i) or whether you determined flow for individual streams routed to the flare as specified in § 98.233(n)(3)(ii). If you measured total flow, indicate whether the volume of gas was determined using a continuous flow measurement device or whether it was determined using parameter monitoring and engineering calculations. If you determined flow for individual streams, indicate for each stream whether flow was determined using a continuous flow measurement device, parameter monitoring and engineering calculations, or other simulation or engineering calculation methods. If you switched from one method to another during the year, then indicate multiple methods were used.
  - (8) Indicate whether a continuous gas composition analyzer was used at the inlet to the flare as specified in § 98.233(n)(4)(i), whether composition at the inlet to the flare was determined based on sampling and analysis as specified in § 98.233(n)(4)(ii), or if composition was determined for individual streams as specified in § 98.233(n)(4)(iii). If you determined composition for individual streams, indicate for each stream whether composition was determined using a continuous gas

composition analyzer, sampling and analysis, or other simulation or engineering calculation methods. If you switched from one method to another during the year, then indicate multiple methods were used.

- (9) Indicate whether you directly measured annual average HHV of the inlet stream to the flare as specified in § 98.233(n)(8)(i), calculated the annual average HHV of the inlet stream to the flare based on composition of the inlet stream as specified in § 98.233(n)(8)(ii), directly measured the annual average HHV of individual streams routed to the flare as specified in § 98.233(n)(8)(iii), or calculated the annual average HHV of individual streams based on their composition as specified in § 98.233(n)(8)(iv).
- (10) Annual average HHV of the inlet stream to the flare determined as specified in § 98.233(n)(8)(i) or (ii); both the calculated flow-weighted annual average HHV of the inlet stream to the flare and each individual stream HHV determined as specified in § 98.233(n)(8)(iii)(B) or (iv)(B); or each individual stream HHV, if you determined HHVs for each individual stream routed to the flare and you used these HHVs to calculate N<sub>2</sub>O emissions for each stream as specified in § 98.233(n)(8)(iii)(A) or (iv)(A).
- (11) Volume of gas sent to the flare, in standard cubic feet (“V<sub>s</sub>” in equations W-19 and W-20 to § 98.233, where V<sub>s</sub> is the total flow at the flare inlet if you measure inlet flow to the flare in accordance with § 98.233(n)(3)(i) or the sum of the V<sub>s</sub> values for individual streams if you measure or determine flow of individual streams in accordance with § 98.233(n)(3)(ii)). If you measure or determine the volume of gas for each stream routed to the flare as specified in § 98.233(n)(3)(ii), then also report the annual volume of each stream, adjusted to exclude any estimated volume that bypassed the flare or determined to have leaked from the closed vent system, and indicate that the flow has been adjusted to account for bypass volume or leaks.
- (12) Fraction of the feed gas sent to an un-lit flare based on total time when continuous monitoring of the pilot or periodic inspections indicated the flare was not lit and measured or calculated flow during the times when the flare was not lit (“Z<sub>U</sub>” in equation W-19 to § 98.233).
- (13) Flare destruction efficiency, expressed as the fraction of hydrocarbon compounds in gas that is destroyed by a burning flare, but may or may not be completely oxidized to CO<sub>2</sub> (§ 98.233(n)(1)). If you used multiple methods during the year, report the flow-weighted average destruction efficiency based on each tier that applied. Report the efficiency fraction to three decimal places.
  - (i) If you use tier 1, report the following:
    - (A) Number of days in periods of 15 or more consecutive days when you did not conform with all cited provisions in § 98.233(n)(1)(i).
    - (B) [Reserved]
  - (ii) If you use tier 2, report the following:
    - (A) Indicate if you are subject to part 60, subpart OOOOb of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter or if you are electing to comply with the flare monitoring requirements in part 60, subpart OOOOb of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter.

- (B) If you are not required to comply with part 60, subpart 0000b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, indicate whether you are electing to comply with § 98.233(n)(1)(ii)(A), (B), (C), or (D).
  - (C) If you are not required to comply with part 60, subpart 0000b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter and the flare is an enclosed ground level flare or an enclosed elevated flare, indicate if your most recent performance test was conducted using the method in § 60.5413b(b) of this chapter (as specified in § 98.233(n)(1)(ii)(A)), the method in § 60.5413b(d) of this chapter (as specified in § 98.233(n)(1)(ii)(C)), or if it was conducted using OTM-52.
  - (D) Number of days in periods of 15 or more consecutive days when you did not conform with all cited provisions in § 98.233(n)(1)(ii).
- (iii) Indicate if you use an alternative test method approved under § 60.5412b(d) of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter. If you use an approved alternative test method, indicate the approved destruction efficiency for the method, the date when you started to use the method, and the name or ID of the method.
- (14) Annual average mole fraction of CH<sub>4</sub> in the feed gas to the flare if you measure composition of the inlet gas as specified in § 98.233(n)(4)(i) or (ii) ("X<sub>CH<sub>4</sub></sub>" in equation W-19 to § 98.233), or the annual average CH<sub>4</sub> mole fractions for each stream if you determine composition of each stream routed to the flare as specified in § 98.233(n)(4)(iii).
  - (15) Except as specified in paragraph (n)(20) of this section, annual average mole fraction of CO<sub>2</sub> in the feed gas to the flare if you measure composition of the inlet gas as specified in § 98.233(n)(4)(i) or (ii) ("X<sub>CO<sub>2</sub></sub>" in equation W-20 to § 98.233), or the annual average CO<sub>2</sub> mole fractions for each stream if you determine composition of each stream routed to the flare as specified in § 98.233(n)(4)(iii).
  - (16) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub> (refer to equation W-20 to § 98.233).
  - (17) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub> (refer to equation W-19 to § 98.233).
  - (18) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O (refer to equation W-40 to § 98.233).
  - (19) Estimated disaggregated CH<sub>4</sub>, CO<sub>2</sub>, and N<sub>2</sub>O emissions attributed to each source type as determined in § 98.233(n)(10) (i.e., AGR vents, dehydrator vents, well venting during completions and workovers with hydraulic fracturing, gas well venting during completions and workovers without hydraulic fracturing, hydrocarbon liquids and produced water storage tanks, well testing venting and flaring, associated gas venting and flaring, other flared sources).
  - (20) Indicate whether a CEMS was used to measure emissions from the flare. If a CEMS was used, then you are not required to report the CO<sub>2</sub> mole fraction in paragraph (n)(15) of this section.
- (o) **Centrifugal compressors.** You must indicate whether your facility has centrifugal compressors. You must report the information specified in paragraphs (o)(1) and (2) of this section for all centrifugal compressors at your facility. For each compressor source or manifolded group of compressor sources that you conduct as found leak measurements as specified in § 98.233(o)(2) or (4), you must report the information specified in paragraph (o)(3) of this section. For each compressor source or manifolded group of compressor sources that you conduct continuous monitoring as specified in § 98.233(o)(3) or (5), you must report the information specified in paragraph (o)(4) of this section. Centrifugal compressors in onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and

boosting that calculate emissions according to § 98.233(o)(10)(iii) are not required to report information in paragraphs (o)(1) through (4) of this section and instead must report the information specified in paragraph (o)(5) of this section.

- (1) **Compressor activity data.** Report the information specified in paragraphs (o)(1)(i) through (xi) of this section, as applicable, for each centrifugal compressor located at your facility.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Unique name or ID for the centrifugal compressor.
  - (iii) Hours in operating-mode.
  - (iv) Hours in standby-pressurized-mode.
  - (v) Hours in not-operating-depressurized-mode.
  - (vi) If you conducted volumetric emission measurements as specified in § 98.233(o)(1):
    - (A) Indicate whether the compressor was measured in operating-mode.
    - (B) Indicate whether the compressor was measured in standby-pressurized-mode.
    - (C) Indicate whether the compressor was measured in not-operating-depressurized-mode.
  - (vii) Indicate whether the compressor has blind flanges installed and associated dates.
  - (viii) Indicate whether the compressor has wet or dry seals.
  - (ix) If the compressor has wet seals, the number of wet seals.
  - (x) If the compressor has dry seals, the number of dry seals.
  - (xi) Power output of the compressor driver (hp).
- (2) **Compressor source.**
  - (i) For each compressor source at each compressor, report the information specified in paragraphs (o)(2)(i)(A) through (C) of this section.
    - (A) Centrifugal compressor name or ID. Use the same ID as in paragraph (o)(1)(ii) of this section.
    - (B) Centrifugal compressor source (wet seal, dry seal, isolation valve, or blowdown valve).
    - (C) Unique name or ID for the leak or vent. If the leak or vent is connected to a manifolded group of compressor sources, use the same leak or vent ID for each compressor source in the manifolded group. If multiple compressor sources are released through a single vent for which continuous measurements are used, use the same leak or vent ID for each compressor source released via the measured vent. For a single compressor using as found measurements, you must provide a different leak or vent ID for each compressor source.
  - (ii) For each leak or vent, report the information specified in paragraphs (o)(2)(ii)(A) through (E) of this section.

- (A) Indicate whether the leak or vent is for a single compressor source or manifolded group of compressor sources and whether the emissions from the leak or vent are released to the atmosphere, routed to a flare, combustion, or vapor recovery system.
  - (B) Indicate whether an as found measurement(s) as identified in § 98.233(o)(2) or (4) was conducted on the leak or vent.
  - (C) Indicate whether continuous measurements as identified in § 98.233(o)(3) or (5) were conducted on the leak or vent.
  - (D) Report emissions as specified in paragraphs (o)(2)(ii)(D)(1) and (2) of this section for the leak or vent. If the leak or vent is routed to a flare, combustion, or vapor recovery system, you are not required to report emissions under this paragraph.
    - (1) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>.
    - (2) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>.
  - (E) If the leak or vent is routed to flare, combustion, or vapor recovery system, report the percentage of time that the respective device was operational when the compressor source emissions were routed to the device.
- (3) **As found measurement sample data.** If the measurement methods specified in § 98.233(o)(2) or (4) are conducted, report the information specified in paragraph (o)(3)(i) of this section. If the calculation specified in § 98.233(o)(6)(ii) is performed, report the information specified in paragraph (o)(3)(ii) of this section.
- (i) For each as found measurement performed on a leak or vent, report the information specified in paragraphs (o)(3)(i)(A) through (F) of this section.
    - (A) Name or ID of leak or vent. Use same leak or vent ID as in paragraph (o)(2)(i)(C) of this section.
    - (B) Measurement date.
    - (C) Measurement method. If emissions were not detected when using a screening method, report the screening method. If emissions were detected using a screening method, report only the method subsequently used to measure the volumetric emissions.
    - (D) Measured flow rate, in standard cubic feet per hour.
    - (E) For each compressor attached to the leak or vent, report the compressor mode during which the measurement was taken.
    - (F) If the measurement is for a manifolded group of compressor sources, indicate whether the measurement location is prior to or after comingling with non-compressor emission sources.
  - (ii) For each compressor mode-source combination where a reporter emission factor as calculated in equation W-23 to § 98.233 was used to calculate emissions in equation W-22 to § 98.233, report the information specified in paragraphs (o)(3)(ii)(A) through (D) of this section.
    - (A) The compressor mode-source combination.
    - (B) The compressor mode-source combination reporter emission factor, in standard cubic feet per hour (EF<sub>s,m</sub> in equation W-23 to § 98.233).

- (C) The total number of compressors measured in the compressor mode-source combination in the current reporting year and the preceding two reporting years ( $\text{Count}_m$  in equation W-23 to § 98.233).
  - (D) Indicate whether the compressor mode-source combination reporter emission factor is facility-specific or based on all of the reporter's applicable facilities.
- (4) **Continuous measurement data.** If the measurement methods specified in § 98.233(o)(3) or (5) are conducted, report the information specified in paragraphs (o)(4)(i) through (iv) of this section for each continuous measurement conducted on each leak or vent associated with each compressor source or manifolded group of compressor sources.
  - (i) Name or ID of leak or vent. Use same leak or vent ID as in paragraph (o)(2)(i)(C) of this section.
  - (ii) Measured volume of flow during the reporting year, in million standard cubic feet.
  - (iii) Indicate whether the measured volume of flow during the reporting year includes compressor blowdown emissions as allowed for in § 98.233(o)(3)(ii) and (o)(5)(iii).
  - (iv) If the measurement is for a manifolded group of compressor sources, indicate whether the measurement location is prior to or after comingling with non-compressor emission sources.
- (5) **Onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting.** Centrifugal compressors with wet seal degassing vents in onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting that calculate emissions according to § 98.233(o)(10)(iii) must report the information specified in paragraphs (o)(5)(i) through (iv) of this section. You must report the information specified in paragraphs (o)(5)(i) through (iv) of this section, as applicable, for each well-pad site (for onshore petroleum and natural gas production) or each gathering and boosting site (for onshore petroleum and natural gas gathering and boosting).
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Report the following activity data.
    - (A) Total number of centrifugal compressors at the facility.
    - (B) Number of centrifugal compressors that have wet seals.
    - (C) Number of centrifugal compressors that have atmospheric wet seal oil degassing vents (i.e., wet seal oil degassing vents where the emissions are released to the atmosphere rather than being routed to flares, combustion, or vapor recovery systems).
  - (iii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from centrifugal compressors with atmospheric wet seal oil degassing vents.
  - (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from centrifugal compressors with atmospheric wet seal oil degassing vents.
- (p) **Reciprocating compressors.** You must indicate whether your facility has reciprocating compressors. You must report the information specified in paragraphs (p)(1) and (2) of this section for all reciprocating compressors at your facility. For each compressor source or manifolded group of compressor sources that you conduct as found leak measurements as specified in § 98.233(p)(2) or (4), you must report the

information specified in paragraph (p)(3) of this section. For each compressor source or manifolded group of compressor sources that you conduct continuous monitoring as specified in § 98.233(p)(3) or (5), you must report the information specified in paragraph (p)(4) of this section. Reciprocating compressors in onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting that calculate emissions according to § 98.233(p)(10)(iii) are not required to report information in paragraphs (p)(1) through (4) of this section and instead must report the information specified in paragraph (p)(5) of this section.

(1) **Compressor activity data.** Report the information specified in paragraphs (p)(1)(i) through (viii) of this section, as applicable, for each reciprocating compressor located at your facility.

- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
- (ii) Unique name or ID for the reciprocating compressor.
- (iii) Hours in operating-mode.
- (iv) Hours in standby-pressurized-mode.
- (v) Hours in not-operating-depressurized-mode.
- (vi) If you conducted volumetric emission measurements as specified in § 98.233(p)(1):
  - (A) Indicate whether the compressor was measured in operating-mode.
  - (B) Indicate whether the compressor was measured in standby-pressurized-mode.
  - (C) Indicate whether the compressor was measured in not-operating-depressurized-mode.
- (vii) Indicate whether the compressor has blind flanges installed and associated dates.
- (viii) Power output of the compressor driver (hp).

(2) **Compressor source.**

- (i) For each compressor source at each compressor, report the information specified in paragraphs (p)(2)(i)(A) through (C) of this section.
  - (A) Reciprocating compressor name or ID. Use the same ID as in paragraph (p)(1)(i) of this section.
  - (B) Reciprocating compressor source (isolation valve, blowdown valve, or rod packing).
  - (C) Unique name or ID for the leak or vent. If the leak or vent is connected to a manifolded group of compressor sources, use the same leak or vent ID for each compressor source in the manifolded group. If multiple compressor sources are released through a single vent for which continuous measurements are used, use the same leak or vent ID for each compressor source released via the measured vent. For a single compressor using as found measurements, you must provide a different leak or vent ID for each compressor source.
- (ii) For each leak or vent, report the information specified in paragraphs (p)(2)(ii)(A) through (E) of this section.

- (A) Indicate whether the leak or vent is for a single compressor source or manifolded group of compressor sources and whether the emissions from the leak or vent are released to the atmosphere, routed to a flare, combustion, or vapor recovery system.
  - (B) Indicate whether an as found measurement(s) as identified in § 98.233(p)(2) or (4) was conducted on the leak or vent.
  - (C) Indicate whether continuous measurements as identified in § 98.233(p)(3) or (5) were conducted on the leak or vent.
  - (D) Report emissions as specified in paragraphs (p)(2)(ii)(D)(1) and (2) of this section for the leak or vent. If the leak or vent is routed to a flare, combustion, or vapor recovery system, you are not required to report emissions under this paragraph.
    - (1) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>.
    - (2) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>.
  - (E) If the leak or vent is routed to a flare, combustion, or vapor recovery system, report the percentage of time that the respective device was operational when the compressor source emissions were routed to the device.
- (3) **As found measurement sample data.** If the measurement methods specified in § 98.233(p)(2) or (4) are conducted, report the information specified in paragraph (p)(3)(i) of this section. If the calculation specified in § 98.233(p)(6)(ii) is performed, report the information specified in paragraph (p)(3)(ii) of this section.
- (i) For each as found measurement performed on a leak or vent, report the information specified in paragraphs (p)(3)(i)(A) through (F) of this section.
    - (A) Name or ID of leak or vent. Use same leak or vent ID as in paragraph (p)(2)(i)(C) of this section.
    - (B) Measurement date.
    - (C) Measurement method. If emissions were not detected when using a screening method, report the screening method. If emissions were detected using a screening method, report only the method subsequently used to measure the volumetric emissions.
    - (D) Measured flow rate, in standard cubic feet per hour.
    - (E) For each compressor attached to the leak or vent, report the compressor mode during which the measurement was taken.
    - (F) If the measurement is for a manifolded group of compressor sources, indicate whether the measurement location is prior to or after comingling with non-compressor emission sources.
  - (ii) For each compressor mode-source combination where a reporter emission factor as calculated in equation W-28 to § 98.233 was used to calculate emissions in equation W-27 to § 98.233, report the information specified in paragraphs (p)(3)(ii)(A) through (D) of this section.
    - (A) The compressor mode-source combination.
    - (B) The compressor mode-source combination reporter emission factor, in standard cubic feet per hour (EF<sub>s,m</sub> in equation W-28 to § 98.233).



- (C) The total number of compressors measured in the compressor mode-source combination in the current reporting year and the preceding two reporting years ( $\text{Count}_m$  in equation W-28 to § 98.233).
  - (D) Indicate whether the compressor mode-source combination reporter emission factor is facility-specific or based on all of the reporter's applicable facilities.
- (4) **Continuous measurement data.** If the measurement methods specified in § 98.233(p)(3) or (5) are conducted, report the information specified in paragraphs (p)(4)(i) through (iv) of this section for each continuous measurement conducted on each leak or vent associated with each compressor source or manifolded group of compressor sources.
  - (i) Name or ID of leak or vent. Use same leak or vent ID as in paragraph (p)(2)(i)(C) of this section.
  - (ii) Measured volume of flow during the reporting year, in million standard cubic feet.
  - (iii) Indicate whether the measured volume of flow during the reporting year includes compressor blowdown emissions as allowed for in § 98.233(p)(3)(ii) and (p)(5)(iii).
  - (iv) If the measurement is for a manifolded group of compressor sources, indicate whether the measurement location is prior to or after comingling with non-compressor emission sources.
- (5) **Onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting.** Reciprocating compressors in onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting that calculate emissions according to § 98.233(p)(10)(iii) must report the information specified in paragraphs (p)(5)(i) through (iv) of this section. You must report the information specified in paragraphs (p)(5)(i) through (iv) of this section, as applicable, for each well-pad site (for onshore petroleum and natural gas production) or each gathering and boosting site (for onshore petroleum and natural gas gathering and boosting).
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Report the following activity data.
    - (A) Total number of reciprocating compressors at the facility.
    - (B) Number of reciprocating compressors that have rod packing emissions vented directly to the atmosphere (*i.e.*, rod packing vents where the emissions are released to the atmosphere rather than being routed to flares, combustion, or vapor recovery systems).
  - (iii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from reciprocating compressors with rod packing emissions vented directly to the atmosphere.
  - (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from reciprocating compressors with rod packing emissions vented directly to the atmosphere.
- (q) **Equipment leak surveys.** For any components subject to or complying with the requirements of § 98.233(q), you must report the information specified in paragraphs (q)(1) and (2) of this section. You must report the information specified in paragraphs (q)(1) and (2) of this section, as applicable, for each well-pad site (for onshore production), gathering and boosting site (for onshore petroleum and natural gas

gathering and boosting), or facility (for all other applicable industry segments). Natural gas distribution facilities with emission sources listed in § 98.232(i)(1) must also report the information specified in paragraph (q)(3) of this section.

- (1) You must report the information specified in paragraphs (q)(1)(i) through (ix) of this section.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Except as specified in paragraph (q)(1)(iii) of this section, the number of complete equipment leak surveys performed during the calendar year.
  - (iii) Natural gas distribution facilities performing equipment leak surveys across a multiple year leak survey cycle must report the number of years in the leak survey cycle.
  - (iv) Except for natural gas distribution facilities and onshore natural gas transmission pipeline facilities, indicate whether any of the leak detection surveys used in calculating emissions per § 98.233(q)(2) were conducted for compliance with any of the standards in paragraphs (q)(1)(iv)(A) through (E) of this section. Report the indication per well-pad site, gathering and boosting site, or facility, not per component type, as applicable.
    - (A) The well site or compressor station fugitive emissions standards in § 60.5397a of this chapter.
    - (B) The well site, centralized production facility, or compressor station fugitive emissions standards in § 60.5397b or § 60.5398b of this chapter.
    - (C) The well site, centralized production facility, or compressor station fugitive emissions standards in an applicable approved state plan or applicable Federal plan in part 62 of this chapter.
    - (D) The standards for equipment leaks at onshore natural gas processing plants in § 60.5400b or § 60.5401b of this chapter.
    - (E) The standards for equipment leaks at onshore natural gas processing plants in an applicable approved state plan or applicable Federal plan in part 62 of this chapter.
  - (v) For facilities in onshore petroleum and natural gas production, onshore petroleum and natural gas gathering and boosting, onshore natural gas transmission compression, underground natural gas storage, LNG storage, and LNG import and export equipment, indicate whether you elected to comply with § 98.233(q) according to § 98.233(q)(1)(iv) for any equipment components at your well-pad site, gathering and boosting site, or facility.
  - (vi) Report each type of method described in § 98.234(a) that was used to conduct leak surveys.
  - (vii) Report whether emissions were calculated using Calculation Method 1 (leaker factor emission calculation methodology) and/or using Calculation Method 2 (leaker measurement methodology).
  - (viii) For facilities in onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting, report the number of major equipment (as listed in table W-1 to this subpart) by service type for which leak detection surveys were conducted and emissions calculated according to § 98.233(q).

- (ix) For facilities in onshore petroleum and natural gas production and onshore petroleum and natural gas gathering and boosting, report the number of major equipment (as listed in table W-1 to this subpart) in vacuum service as defined in § 98.238.
- (2) You must indicate whether your facility contains any of the component types subject to or complying with § 98.233(q) that are listed in § 98.232(c)(21), (d)(7), (e)(7) or (8), (f)(5) through (8), (g)(4), (g)(6) or (7), (h)(5), (h)(7) or (8), (i)(1), (j)(10), (m)(3)(ii) or (m)(4)(ii) for your facility's industry segment. For each component type and leak detection method combination that is located at your well-pad site, gathering and boosting site, or facility, you must report the information specified in paragraphs (q)(2)(i) through (ix) of this section. If a component type is located at your well-pad site, gathering and boosting site, or facility and no leaks were identified from that component, then you must report the information in paragraphs (q)(2)(i) through (ix) of this section but report a zero ("0") for the information required according to paragraphs (q)(2)(vi) through (ix) of this section. If you used Calculation Method 1 (leaker factor emission calculation methodology) for some complete leak surveys and used Calculation Method 2 (leaker measurement methodology) for some complete leak surveys, you must report the information specified in paragraphs (q)(2)(i) through (ix) of this section separately for component surveys using Calculation Method 1 and Calculation Method 2.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Component type.
  - (iii) Leak detection method used for the screening survey (e.g., Method 21 as specified in § 98.234(a)(2)(i); Method 21 as specified in § 98.234(a)(2)(ii); and OGI and other leak detection methods as specified in § 98.234(a)(1), (3), or (5)).
  - (iv) Emission factor or measurement method used (e.g., default emission factor; facility-specific emission factor developed according to § 98.233(q)(4); or direct measurement according to § 98.233(q)(3)).
  - (v) Total number of components surveyed by type and leak detection method in the calendar year.
  - (vi) Total number of the surveyed component types by leak detection method that were identified as leaking in the calendar year ("xp" in equation W-30 to § 98.233 for the component type or the number of leaks measured for the specified component type according to the provisions in § 98.233(q)(3)).
  - (vii) Average time the surveyed components are assumed to be leaking and operational, in hours (average of " $T_{p,z}$ " from equation W-30 to § 98.233 for the component type or average duration of leaks for the specified component type determined according to the provisions in § 98.233(q)(3)(ii)).
  - (viii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for the component type as calculated using equation W-30 to § 98.233 or § 98.233(q)(3)(vii) (for surveyed components only).
  - (ix) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for the component type as calculated using equation W-30 to § 98.233 or § 98.233(q)(3)(vii) (for surveyed components only).
- (3) Natural gas distribution facilities with emission sources listed in § 98.232(i)(1) must also report the information specified in paragraphs (q)(3)(i) through (viii) and, if applicable, (q)(3)(ix) of this section.

- (i) Number of above grade transmission-distribution transfer stations surveyed in the calendar year.
- (ii) Number of meter/regulator runs at above grade transmission-distribution transfer stations surveyed in the calendar year ("Count<sub>MR,y</sub>" from equation W-31 to § 98.233, for the current calendar year).
- (iii) Average time that meter/regulator runs surveyed in the calendar year were operational, in hours (average of "T<sub>w,y</sub>" from equation W-31 to § 98.233, for the current calendar year).
- (iv) Number of above grade transmission-distribution transfer stations surveyed in the current leak survey cycle.
- (v) Number of meter/regulator runs at above grade transmission-distribution transfer stations surveyed in current leak survey cycle (sum of "Count<sub>MR,y</sub>" from equation W-31 to § 98.233, for all calendar years in the current leak survey cycle).
- (vi) Average time that meter/regulator runs surveyed in the current leak survey cycle were operational, in hours (average of "T<sub>w,y</sub>" from equation W-31 to § 98.233, for all years included in the leak survey cycle).
- (vii) Meter/regulator run CO<sub>2</sub> emission factor based on all surveyed transmission-distribution transfer stations in the current leak survey cycle, in standard cubic feet of CO<sub>2</sub> per operational hour of all meter/regulator runs ("EF<sub>s,MR,i</sub>" for CO<sub>2</sub> calculated using equation W-31 to § 98.233).
- (viii) Meter/regulator run CH<sub>4</sub> emission factor based on all surveyed transmission-distribution transfer stations in the current leak survey cycle, in standard cubic feet of CH<sub>4</sub> per operational hour of all meter/regulator runs ("EF<sub>s,MR,i</sub>" for CH<sub>4</sub> calculated using equation W-31 to § 98.233).
- (ix) If your natural gas distribution facility performs equipment leak surveys across a multiple year leak survey cycle, you must also report:
  - (A) The total number of meter/regulator runs at above grade transmission-distribution transfer stations at your facility ("Count<sub>MR</sub>" in equation W-32B to § 98.233).
  - (B) Average estimated time that each meter/regulator run at above grade transmission-distribution transfer stations was operational in the calendar year, in hours per meter/regulator run ("T<sub>w,avg</sub>" in equation W-32B to § 98.233).
  - (C) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for all above grade transmission-distribution transfer stations at your facility.
  - (D) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for all above grade transmission-distribution transfer stations at your facility.

(r) **Equipment leaks by population count.** If your facility is subject to the requirements of § 98.233(r), then you must report the information specified in paragraphs (r)(1) through (3) of this section, as applicable. You must report the information specified in paragraphs (r)(1) through (3) of this section, as applicable, for each well-pad site (for onshore petroleum and natural gas production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments).

- (1) You must indicate whether your facility contains any of the emission source types required to use equation W-32A to § 98.233. You must report the information specified in paragraphs (r)(1)(i) through (vi) of this section separately for each emission source type required to use equation W-32A to § 98.233 that is located at your facility. For each well-pad site and gathering and boosting site at onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities, you must report the information specified in paragraphs (r)(1)(i) through (vi) of this section separately by equipment type and service type.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Emission source type. Onshore petroleum and natural gas production facilities and onshore petroleum and natural gas gathering and boosting facilities must report the equipment type and service type.
  - (iii) Total number of the emission source type at the well-pad site, gathering and boosting site, or facility, as applicable ("Count<sub>e</sub>" in equation W-32A to § 98.233).
  - (iv) Average estimated time that the emission source type was operational in the calendar year, in hours ("T<sub>e</sub>" in equation W-32A to § 98.233).
  - (v) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, for the emission source type.
  - (vi) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, for the emission source type.
- (2) Natural gas distribution facilities must also report the information specified in paragraphs (r)(2)(i) through (v) of this section.
  - (i) Number of above grade transmission-distribution transfer stations at the facility.
  - (ii) Number of above grade metering-regulating stations that are not transmission-distribution transfer stations at the facility.
  - (iii) Total number of meter/regulator runs at above grade metering-regulating stations that are not above grade transmission-distribution transfer stations ("Count<sub>MR</sub>" in equation W-32B to § 98.233).
  - (iv) Average estimated time that each meter/regulator run at above grade metering-regulating stations that are not above grade transmission-distribution transfer stations was operational in the calendar year, in hours per meter/regulator run ("T<sub>w,avg</sub>" in equation W-32B to § 98.233).
  - (v) If your facility has above grade metering-regulating stations that are not above grade transmission-distribution transfer stations and your facility also has above grade transmission-distribution transfer stations, you must also report:
    - (A) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from above grade metering-regulating stations that are not above grade transmission-distribution transfer stations.
    - (B) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from above grade metering-regulating stations that are not above grade transmission-distribution transfer stations.

- (3) You must indicate whether your facility contains any emission source types in vacuum service as defined in § 98.238. If your facility contains equipment in vacuum service, you must report the information specified in paragraphs (r)(3)(i) through (iii) of this section separately for each emission source type in vacuum service that is located at your well-pad site, gathering and boosting site, or facility, as applicable.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Emission source type.
  - (iii) Total number of the emission source type at the well-pad site, gathering and boosting site, or facility, as applicable.

(s) **Offshore petroleum and natural gas production.** You must report the information specified in paragraphs (s)(1) through (3) of this section for your facility.

- (1) The BOEM Facility ID(s) that correspond(s) to your facility, if applicable.
- (2) If you adjusted emissions according to § 98.233(s)(1)(ii) or (s)(2)(ii), report the information specified in paragraphs (s)(2)(i) and (ii) of this section.
  - (i) Facility operating hours for the year of the most recent emissions calculated according to § 98.233(s)(1)(ii) or § 98.233(s)(2)(ii) prior to the current reporting year.
  - (ii) Facility operating hours for the current reporting year.
- (3) For each emission source type listed in the most recent monitoring and calculation methods published by BOEM as referenced in 30 CFR 550.302 through 304, report the information specified in paragraphs (s)(3)(i) through (iii) of this section.
  - (i) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>.
  - (ii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>.
  - (iii) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O.

(t)-(v) [Reserved]

(w) **EOR injection pumps.** You must indicate whether CO<sub>2</sub> EOR injection was used at your facility during the calendar year and if any EOR injection pump blowdowns occurred during the year. If any EOR injection pump blowdowns occurred during the calendar year, then you must report the information specified in paragraphs (w)(1) through (8) of this section for each EOR injection pump system.

- (1) Sub-basin ID.
- (2) EOR injection pump system identifier.
- (3) Pump capacity, in barrels per day.
- (4) Total volume of EOR injection pump system equipment chambers, in cubic feet ("V<sub>v</sub>" in equation W-37 to § 98.233).
- (5) Number of blowdowns for the EOR injection pump system in the calendar year.

- (6) Density of critical phase EOR injection gas, in kilograms per cubic foot ("Rc" in equation W-37 to § 98.233).
- (7) Mass fraction of CO<sub>2</sub> in critical phase EOR injection gas ("GHG<sub>CO2</sub>" in equation W-37 to § 98.233).
- (8) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from EOR injection pump system blowdowns.
- (x) **EOR hydrocarbon liquids.** You must indicate whether hydrocarbon liquids were produced through EOR operations. If hydrocarbon liquids were produced through EOR operations, you must report the information specified in paragraphs (x)(1) through (4) of this section for each sub-basin category with EOR operations.
  - (1) Sub-basin ID.
  - (2) Total volume of hydrocarbon liquids produced through EOR operations in the calendar year, in barrels ("V<sub>hl</sub>" in equation W-38 to § 98.233).
  - (3) Average CO<sub>2</sub> retained in hydrocarbon liquids downstream of the storage tank, in metric tons per barrel under standard conditions ("S<sub>hl</sub>" in equation W-38 to § 98.233).
  - (4) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from CO<sub>2</sub> retained in hydrocarbon liquids produced through EOR operations downstream of the storage tank ("MassCO<sub>2</sub>" in equation W-38 to § 98.233).
- (y) **Other large release events.** You must indicate whether there were any other large release events from your facility during the reporting year and indicate whether your facility was notified of a potential super-emitter release under the provisions of § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter. If there were any other large release events, you must report the total number of other large release events from your facility that occurred during the reporting year and, for each other large release event, report the information specified in paragraphs (y)(1) through (10) of this section. If you received a super-emitter release notification under the provisions of § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter that the EPA has not determined to contain a demonstrable error according to the provisions in § 98.233(y)(6), you must include the emissions from that source or event within your subpart W report unless you can provide certification that the facility does not own or operate the equipment at the location identified in the notification using the methods specified in § 98.233(y)(6). Regardless, if you received a super-emitter release notification under the provisions of §§ 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, you must also report the information specified in paragraph (y)(11) of this section.
  - (1) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (2) Unique release event identification number (e.g., Event 1, Event 2).
  - (3) The latitude and longitude of the release in decimal degrees to at least four digits to the right of the decimal point.

- (4) The approximate start date, start time, and duration (in hours) of the release event, and an indication of how the start date and time were determined (determined based on pressure monitor, temperature monitor, other monitored process parameter (specify), assigned based on last monitoring or measurement survey showing no large release (specify monitoring or measurement survey method), or used the 91-day default start date).
- (5) A general description of the event. Include:
  - (i) Identification of the equipment involved in the release.
  - (ii) A description of how the release occurred, from one of the following categories: maintenance event, fire/explosion, gas well blowout, oil well blowout, gas well release, oil well release, pressure relief, large leak, and other (specify).
  - (iii) An indication of whether the release exceeded a threshold in § 98.233(y)(1)(i) or in § 98.233(y)(1)(ii).
  - (iv) A description of the technology or method used to identify the release.
  - (v) An indication of whether the release was identified under the provisions of § 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter and, if the release was identified under the provisions of §§ 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter, a unique notification ID number for the notification as assigned in paragraph (y)(11)(i) of this section.
  - (vi) An indication of whether a portion of the natural gas released was combusted during the release, and if so, the fraction of the natural gas released that was estimated to be combusted and the assumed combustion efficiency for the combusted natural gas.
- (6) The total volume of gas released during the event in standard cubic feet.
- (7) The volume fraction of CO<sub>2</sub> in the gas released during the event.
- (8) The volume fraction of CH<sub>4</sub> in the gas released during the event.
- (9) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, from the release event that occurred during the reporting year.
- (10) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from the release event that occurred during the reporting year and the maximum CH<sub>4</sub> emissions rate, in kilograms per hour, determined for any period of the event according to the provisions § 98.233(y)(2)(i).
- (11) Report the total number of super-emitter release notifications received from the EPA under the provisions of §§ 60.5371, 60.5371a, or 60.5371b of this chapter or an applicable approved state plan or applicable Federal plan in part 62 of this chapter for this facility for events that occurred during the reporting year that were not determined by the EPA to have a demonstratable error in the notification and, for each such super-emitter release notification, report the information specified in paragraphs (y)(11)(i) through (v) of this section.



- (i) Unique notification identification number (e.g., Notification\_01, Notification\_02). If a unique notification number was provided with a notification received under the provisions of § 60.5371, 60.5371a, or 60.5371b of this chapter, an applicable approved state plan, or applicable Federal plan in part 62 of this chapter, report the number associated with the event provided in the notification.
- (ii) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only) to which the notification was attributed.
- (iii) Based on any assessment or investigation triggered by the notification, indicate if the emissions were from normal operations, a planned maintenance event, leaking equipment, malfunctioning equipment or device, or undetermined cause.
- (iv) An indication of whether the emissions identified via the notification are included in annual emissions reported under this subpart and, if so, the source type under which the emissions identified via the notification are reported (from the list of source types required to be reported as specified in § 98.232 for the facility's applicable industry segment). If the emissions were reported following the requirements of § 98.233(y) as an other large release event, report the unique release event identification number assigned to the other large release event as reported in paragraph (y)(2) of this section. If the emissions identified via the notification are not included in the annual emissions reported under this subpart, you must provide certification that the facility does not own or operate the equipment at the location identified in the notification as specified in § 98.233(y)(6)(i) or provide certification that the facility conducted a complete investigation of the site as specified in § 98.233(y)(6)(ii) and does not own or operate the emitting equipment at the location identified in the notification.
- (v) Provide an indication if you received a super-emitter release notification from the EPA after December 31 of the reporting year for which investigations are on-going such that the annual report that has been submitted may be revised and resubmitted pending the outcome of the super-emitter investigation.

(z) **Combustion equipment.** If your facility is required by § 98.232(c)(22), (i)(7), or (j)(12) to report emissions from combustion equipment, then you must indicate whether your facility has any combustion units subject to reporting according to paragraph (a)(1)(xx), (a)(8)(vi), or (a)(9)(xiii) of this section. If your facility contains any combustion units subject to reporting according to paragraph (a)(1)(xx), (a)(8)(vi), or (a)(9)(xiii) of this section, then you must report the information specified in paragraphs (z)(1) and (2) of this section, as applicable. You must report the information specified in paragraphs (z)(1) and (2) of this section, as applicable, for each well-pad site (for onshore petroleum and natural gas production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments).

- (1) Indicate whether the combustion units include: External fuel combustion units with a rated heat capacity less than or equal to 5 million Btu per hour; or, internal fuel combustion units that are not compressor-drivers, with a rated heat capacity less than or equal to 1 mmBtu/hr (or the equivalent of 130 horsepower). If the facility contains external fuel combustion units with a rated heat capacity less than or equal to 5 million Btu per hour or internal fuel combustion units that are not compressor-drivers, with a rated heat capacity less than or equal to 1 million Btu per hour (or the equivalent of 130 horsepower), then you must report the information specified in paragraphs (z)(1)(i) through (iii) of this section for each unit type.

- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) The type of combustion unit.
  - (iii) The total number of combustion units.
- (2) Indicate whether the combustion units include: External fuel combustion units with a rated heat capacity greater than 5 million Btu per hour; internal fuel combustion units that are not compressor-drivers, with a rated heat capacity greater than 1 million Btu per hour (or the equivalent of 130 horsepower); or, internal fuel combustion units of any heat capacity that are compressor-drivers. For each type of combustion unit at your facility, you must report the information specified in paragraphs (z)(2)(i) through (iv) and (z)(2)(viii) through (x) of this section, except for internal fuel combustion units that are not compressor-drivers, with a rated heat capacity greater than 1 million Btu per hour (or the equivalent of 130 horsepower) or internal fuel combustion units of any heat capacity that are compressor-drivers that combust natural gas meeting the criteria in § 98.233(z)(1) or (2) or a fuel meeting the criteria in § 98.233(z)(3), which must report the information specified in paragraphs (z)(2)(i) through (x) of this section. Information must be reported for each combustion unit type, fuel type, and method for determining the CH<sub>4</sub> emission factor combination, as applicable.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) The type of combustion unit including external fuel combustion units with a rated heat capacity greater than 5 million Btu per hour; internal fuel combustion units that are not compressor-drivers, with a rated heat capacity greater than 1 million Btu per hour (or the equivalent of 130 horsepower); or internal fuel combustion units of any heat capacity that are compressor-drivers.
  - (iii) The type of fuel combusted.
  - (iv) The quantity of fuel combusted in the calendar year, in thousand standard cubic feet, gallons, or tons.
  - (v) The equipment type, including reciprocating 2-stroke-lean burn, reciprocating 4-stroke lean-burn, reciprocating 4-stroke rich-burn, and gas turbine.
  - (vi) The method used to determine the methane emission factor, including the default emission factor from table W-7 to this subpart, OEM data, or performance tests in § 98.234(i) for natural gas described in § 98.233(z)(1) or (2), or performance tests in § 98.234(i) or default combustion efficiency for fuels described in section § 98.233(z)(3).
  - (vii) The value of the CH<sub>4</sub> emission factor (kg CH<sub>4</sub>/mmBtu). If multiple performance tests were performed in the same reporting year, the arithmetic average value of CH<sub>4</sub> emission factor (kg CH<sub>4</sub>/mmBtu). This information is not required if CH<sub>4</sub> emissions were calculated per § 98.233(z)(3)(ii)(D).
  - (viii) Annual CO<sub>2</sub> emissions, in metric tons CO<sub>2</sub>, calculated according to § 98.233(z)(1) through (3).
  - (ix) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, calculated according to § 98.233(z)(1) through (3).
  - (x) Annual N<sub>2</sub>O emissions, in metric tons N<sub>2</sub>O, calculated according to § 98.233(z)(1) through (3).

(aa) **Industry segment-specific information.** Each facility must report the information specified in paragraphs (aa)(1) through (11) of this section, for each applicable industry segment, determined using a flow meter that meets the requirements of § 98.234(b) for quantities that are sent to sale or through the facility and determined by using best available data for other quantities. If a quantity required to be reported is zero, you must report zero as the value.

(1) For onshore petroleum and natural gas production, report the data specified in paragraphs (aa)(1)(i) and (iv) of this section.

(i) Report the information specified in paragraphs (aa)(1)(i)(A) through (C) of this section for the basin as a whole, unless otherwise specified.

(A) The quantity of gas produced in the calendar year from wells, in thousand standard cubic feet. This includes gas that is routed to a pipeline, vented or flared, or used in field operations. This does not include gas injected back into reservoirs or shrinkage resulting from lease condensate production.

(B) The quantity of natural gas produced from producing wells that is sent to sale in the calendar year, in thousand standard cubic feet.

(C) The quantity of crude oil and condensate produced from producing wells that is sent to sale in the calendar year, in barrels.

(ii) Report the information specified in paragraphs (aa)(1)(ii)(A) through (M) of this section for each unique sub-basin category.

(A) State.

(B) County.

(C) Formation type.

(D) The number of producing wells at the end of the calendar year (exclude only those wells permanently shut-in and plugged).

(E) The number of producing wells acquired during the calendar year.

(F) The number of producing wells divested during the calendar year.

(G) The number of wells completed during the calendar year.

(H) The number of wells permanently shut-in and plugged during the calendar year.

(I) Average mole fraction of CH<sub>4</sub> in produced gas.

(J) Average mole fraction of CO<sub>2</sub> in produced gas.

(K) If an oil sub-basin, report the average GOR of all wells, in thousand standard cubic feet per barrel.

(L) If an oil sub-basin, report the average API gravity of all wells.

(M) If an oil sub-basin, report average low pressure separator pressure, in pounds per square inch gauge.

(iii) Report the information specified in paragraphs (aa)(1)(iii)(A) through (D) of this section for each well located in the facility.

- (A) Well ID number.
  - (B) Well-pad ID.
  - (C) For each well permanently shut-in and plugged during the calendar year, the quantity of natural gas produced that is sent to sale in the calendar year, in thousand standard cubic feet.
  - (D) For each well permanently shut-in and plugged during the calendar year, the quantity of crude oil and condensate produced that is sent to sale in the calendar year, in barrels.
- (iv) Report the information specified in paragraphs (aa)(1)(iv)(A) through (C) of this section for each well-pad site located in the facility.
  - (A) A unique name or ID number for the well-pad.
  - (B) Sub-basin ID.
  - (C) The latitude and longitude of the well-pad representing the geographic centroid or center point of the well-pad in decimal degrees to at least four digits to the right of the decimal point.
- (2) For offshore production, report the quantities specified in paragraphs (aa)(2)(i) through (iv) of this section.
  - (i) The quantity of natural gas produced from producing wells that is sent to sale in the calendar year, in thousand standard cubic feet.
  - (ii) The quantity of crude oil and condensate produced from producing wells that is sent to sale in the calendar year, in barrels.
  - (iii) For each well permanently shut-in and plugged during the calendar year, the quantity of natural gas produced that is sent to sale in the calendar year, in thousand standard cubic feet.
  - (iv) For each well permanently shut-in and plugged during the calendar year, the quantity of crude oil and condensate produced that is sent to sale in the calendar year, in barrels.
- (3) For natural gas processing, if your facility fractionates NGLs and also reported as a supplier to subpart NN of this part under the same e-GGRT identification number in the calendar year, you must report the information specified in paragraphs (aa)(3)(ii) and (aa)(3)(v) through (ix) of this section. Otherwise, report the information specified in paragraphs (aa)(3)(i) through (ix) of this section.
  - (i) The quantity of natural gas received at the gas processing plant for processing in the calendar year, in thousand standard cubic feet.
  - (ii) The quantity of processed (residue) gas leaving the gas processing plant in the calendar year, in thousand standard cubic feet.
  - (iii) The cumulative quantity of all NGLs (bulk and fractionated) received at the gas processing plant in the calendar year, in barrels.
  - (iv) The cumulative quantity of all NGLs (bulk and fractionated) leaving the gas processing plant in the calendar year, in barrels.
  - (v) Average mole fraction of CH<sub>4</sub> in natural gas received.
  - (vi) Average mole fraction of CO<sub>2</sub> in natural gas received.

- (vii) Indicate whether the facility fractionates NGLs.
  - (viii) Indicate whether the facility reported as a supplier to subpart NN of this part under the same e-GGRT identification number in the calendar year.
  - (ix) The quantity of residue gas leaving that has been processed by the facility and any gas that passes through the facility to sales without being processed by the facility.
- (4) For natural gas transmission compression, report the quantity specified in paragraphs (aa)(4)(i) through (v) of this section.
- (i) The quantity of natural gas transported through the compressor station in the calendar year, in thousand standard cubic feet.
  - (ii) Number of compressors.
  - (iii) Total compressor power rating of all compressors combined, in horsepower.
  - (iv) Average upstream pipeline pressure, in pounds per square inch gauge.
  - (v) Average downstream pipeline pressure, in pounds per square inch gauge.
- (5) For underground natural gas storage, report the quantities specified in paragraphs (aa)(5)(i) through (iii) of this section.
- (i) The quantity of gas injected into storage in the calendar year, in thousand standard cubic feet.
  - (ii) The quantity of natural gas withdrawn from storage and sent to sale in the calendar year, in thousand standard cubic feet.
  - (iii) Total storage capacity, in thousand standard cubic feet.
- (6) For LNG import equipment, report the quantity of LNG imported that is sent to sale in the calendar year, in thousand standard cubic feet.
- (7) For LNG export equipment, report the quantity of LNG exported that is sent to sale in the calendar year, in thousand standard cubic feet.
- (8) For LNG storage, report the quantities specified in paragraphs (aa)(8)(i) through (iii) of this section.
- (i) The quantity of LNG added into storage in the calendar year, in thousand standard cubic feet.
  - (ii) The quantity of LNG withdrawn from storage and sent to sale in the calendar year, in thousand standard cubic feet.
  - (iii) Total storage capacity, in thousand standard cubic feet.
- (9) [Reserved]
- (10) For onshore petroleum and natural gas gathering and boosting facilities, report the quantities specified in paragraphs (aa)(10)(i) through (v) of this section.
- (i) The quantity of gas received by the gathering and boosting facility in the calendar year, in thousand standard cubic feet.
  - (ii) The quantity of natural gas transported from the gathering and boosting facility in the calendar year, in thousand standard cubic feet.

- (iii) The quantity of all hydrocarbon liquids received by the gathering and boosting facility in the calendar year, in barrels.
- (iv) The quantity of all hydrocarbon liquids transported from the gathering and boosting facility in the calendar year, in barrels.
- (v) Report the information specified in paragraphs (aa)(10)(v)(A) through (E) of this section for each gathering and boosting site located in the facility for which there were emissions in the calendar year.
  - (A) A unique name or ID number for the gathering and boosting site.
  - (B) Gathering and boosting site type (gathering compressor station, centralized oil production site, gathering pipeline, or other fence-line site).
  - (C) State.
  - (D) For gathering compressor stations, centralized oil production sites, and other fence-line sites, county.
  - (E) For gathering compressor stations, centralized oil production sites, and other fence-line sites, the latitude and longitude of the gathering and boosting site representing the geographic centroid or center point of the site in decimal degrees to at least four digits to the right of the decimal point.

(11) For onshore natural gas transmission pipeline facilities, report the quantities specified in paragraphs (aa)(11)(i) through (vi) of this section.

- (i) The quantity of natural gas received at all custody transfer stations in the calendar year, in thousand standard cubic feet. This value may include meter corrections, but only for the calendar year covered by the annual report.
- (ii) The quantity of natural gas withdrawn from underground natural gas storage and LNG storage (regasification) facilities owned and operated by the onshore natural gas transmission pipeline owner or operator that are not subject to this subpart in the calendar year, in thousand standard cubic feet.
- (iii) The quantity of natural gas added to underground natural gas storage and LNG storage (liquefied) facilities owned and operated by the onshore natural gas transmission pipeline owner or operator that are not subject to this subpart in the calendar year, in thousand standard cubic feet.
- (iv) The quantity of natural gas transported through the facility and transferred to third parties such as LDCs or other transmission pipelines, in thousand standard cubic feet.
- (v) The quantity of natural gas consumed by the transmission pipeline facility for operational purposes, in thousand standard cubic feet.
- (vi) The miles of transmission pipeline for each state in the facility.

(bb) **Missing data.** For any missing data procedures used, report the information in § 98.3(c)(8) and the procedures used to substitute an unavailable value of a parameter, except as provided in paragraphs (bb)(1) and (2) of this section.

- (1) For quarterly measurements, report the total number of quarters that a missing data procedure was used for each data element rather than the total number of hours.
- (2) For annual or biannual (once every two years) measurements, you do not need to report the number of hours that a missing data procedure was used for each data element.

- (cc) **Delay in reporting for wildcat wells and delineation wells.** If you elect to delay reporting the information in paragraph (g)(5)(i) or (ii), (g)(5)(iii)(A) or (B), (h)(1)(iv), (h)(2)(iv), (j)(1)(iii), (j)(2)(i)(A), (l)(1)(v), (l)(2)(v), (l)(3)(iv), (l)(4)(iv), (m)(5) or (6), (dd)(1)(iii), (dd)(1)(vi)(A), (B), or (C), (dd)(3)(iii)(A), or (dd)(3)(iii)(D)(1), (2), or (3) of this section, you must report the information required in that paragraph no later than the date 2 years following the date specified in § 98.3(b) introductory text.
- (dd) **Drilling mud degassing.** You must indicate whether there were mud degassing operations at your facility, and if so, which methods (as specified in § 98.233(dd)) were used to calculate emissions. For wells for which your facility performed mud degassing operations and used Calculation Method 1, then you must report the information specified in paragraph (dd)(1) of this section. For wells for which your facility performed mud degassing operations and used Calculation Method 2, then you must report the information specified in paragraph (dd)(2) of this section. For wells for which your facility performed mud degassing operations and used Calculation Method 3, then you must report the information specified in paragraph (dd)(3) of this section.
- (1) For each well for which you used Calculation Method 1 to calculate natural gas emissions from mud degassing, report the information specified in paragraphs (dd)(1)(i) through (viii) of this section.
    - (i) Well ID number.
    - (ii) Approximate total depth below surface, in feet.
    - (iii) Target hydrocarbon-bearing stratigraphic formation to which the well is drilled.
    - (iv) Total time that drilling mud is circulated in the well ( $T_r$  in equation W-41 to § 98.233 and  $T_p$  in equation W-43 to § 98.233), in minutes, beginning with initial penetration of the first hydrocarbon-bearing zone until drilling mud ceases to be circulated in the wellbore. You may delay reporting of this data element for a representative well if you indicate in the annual report that one or more wells to which the calculated  $\text{CH}_4$  emissions rate for the representative well ( $\text{ER}_{\text{s,CH}_4,\text{r}}$  in equation W-42 to § 98.233) is applied is a wildcat well or delineation well. You may delay reporting of this data element for any well if you indicate in the annual report that the well is a wildcat or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total time that drilling mud is circulated in the well, in minutes.
    - (v) The composition of the drilling mud: water-based, oil-based, or synthetic.
    - (vi) If the well is not a representative well, Well ID number of the representative well used to derive the  $\text{CH}_4$  emission rate used to calculate  $\text{CH}_4$  emissions for this well.
    - (vii) If the well is a representative well, report the information specified in paragraphs (dd)(1)(vi)(A) through (D) of this section.
      - (A) Average mud rate ( $\text{MR}_r$  in equation W-41 to § 98.233), in gallons per minute. You may delay reporting of this data element if you indicate in the annual report that one or more wells to which the calculated  $\text{CH}_4$  emissions rate for the representative well ( $\text{ER}_{\text{s,CH}_4,\text{r}}$  in

equation W-42 to § 98.233) is applied is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the average mud rate, in gallons per minute.

- (B) Average concentration of natural gas in the drilling mud ( $X_n$  in equation W-41 to § 98.233), in parts per million. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the average concentration of natural gas in the drilling mud in parts per million.
  - (C) Measured mole fraction for CH<sub>4</sub> in natural gas entrained in the drilling mud ( $GHG_{CH_4}$  in equation W-41 to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured mole fraction for CH<sub>4</sub> in natural gas entrained in the drilling mud.
  - (D) Calculated CH<sub>4</sub> emissions rate in standard cubic feet per minute ( $ER_{s,CH_4,r}$  in equation W-42 to § 98.233). You may delay reporting of this data element if you indicate in the annual report that that one or more wells to which the calculated CH<sub>4</sub> emissions rate for the representative well ( $ER_{s,CH_4,r}$  in equation W-42 to § 98.233) is applied is a wildcat or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the calculated CH<sub>4</sub> emissions rate in standard cubic feet per minute.
- (viii) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from well drilling mud degassing, calculated according to § 98.233(dd)(1).
- (2) For each well for which you used Calculation Method 2 to calculate natural gas emissions from mud degassing, report the information specified in paragraphs (dd)(2)(i) through (iv) of this section.
- (i) Well ID number.
  - (ii) Total number of drilling days ( $DD_p$  in equation W-44 to § 98.233).
  - (iii) The composition of the drilling mud: water-based, oil-based, or synthetic.
  - (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, from drilling mud degassing, calculated according to § 98.233(dd)(2).
- (3) For each well for which you used Calculation Method 3 to calculate natural gas emissions from mud degassing, report the information specified in paragraphs (dd)(3)(i) through (iv) of this section.
- (i) Well ID number.
  - (ii) For the time periods you used Calculation Method 1 to calculate natural gas emissions from mud degassing, report the information specified in paragraphs (dd)(3)(ii)(A) through (G) of this section.
    - (A) Approximate total depth below surface, in feet.
    - (B) Target hydrocarbon-bearing stratigraphic formation to which the well is drilled.



- (C) Total time that drilling mud is circulated in the well ( $T_r$  in equation W-41 to § 98.233 and  $T_p$  in equation W-43 to § 98.233), in minutes, beginning with initial penetration of the first hydrocarbon-bearing zone until drilling mud ceases to be circulated in the wellbore. You may delay reporting of this data element for a representative well if you indicate in the annual report that that one or more wells to which the calculated  $\text{CH}_4$  emissions rate for the representative well ( $ER_{s,\text{CH}_4,r}$  in equation W-42 to § 98.233) is applied is a wildcat well or delineation well. You may delay reporting of this data element for any well if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the total time that drilling mud is circulated in the well, in minutes.
- (D) The composition of the drilling mud: water-based, oil-based, or synthetic.
- (E) If the well is not a representative well, Well ID number of the representative well used to derive the  $\text{CH}_4$  emission rate used to calculate  $\text{CH}_4$  emissions for this well.
- (F) If the well is a representative well, report the information specified in paragraphs (dd)(3)(ii)(F)(1) through (4) of this section.
  - (1) Average mud rate ( $MR_r$  in equation W-41 to § 98.233), in gallons per minute. You may delay reporting of this data element if you indicate in the annual report that one or more wells to which the calculated  $\text{CH}_4$  emissions rate for the representative well ( $ER_{s,\text{CH}_4,r}$  in equation W-42 to § 98.233) is applied is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the average mud rate, in gallons per minute.
  - (2) Average concentration of natural gas in the drilling mud ( $X_n$  in equation W-41 to § 98.233), in parts per million. You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the average concentration of natural gas in the drilling mud in parts per million.
  - (3) Measured mole fraction for  $\text{CH}_4$  in natural gas entrained in the drilling mud ( $\text{GHG}_{\text{CH}_4}$  in equation W-41 to § 98.233). You may delay reporting of this data element if you indicate in the annual report that the well is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the measured mole fraction for  $\text{CH}_4$  in natural gas entrained in the drilling mud.
  - (4) Calculated  $\text{CH}_4$  emissions rate in standard cubic feet per minute ( $ER_{s,\text{CH}_4,r}$  in equation W-42 to § 98.233). You may delay reporting of this data element if you indicate in the annual report that one or more wells to which the calculated  $\text{CH}_4$  emissions rate for the representative well ( $ER_{s,\text{CH}_4,r}$  in equation W-42 to § 98.233) is applied is a wildcat well or delineation well. If you elect to delay reporting of this data element, you must report by the date specified in paragraph (cc) of this section the calculated  $\text{CH}_4$  emissions rate in standard cubic feet per minute.
- (G) Annual  $\text{CH}_4$  emissions, in metric tons  $\text{CH}_4$ , from well drilling mud degassing, calculated according to § 98.233(dd)(1).

- (iii) For the time periods for each well for which you used Calculation Method 2 to calculate natural gas emissions from mud degassing, report the information specified in paragraphs (dd)(3)(iii)(A) through (C) of this section.
  - (A) Total number of drilling days ( $DD_p$  in equation W-44 to § 98.233).
  - (B) The composition of the drilling mud: water-based, oil-based, or synthetic.
  - (C) Annual  $CH_4$  emissions, in metric tons  $CH_4$ , from drilling mud degassing, calculated according to § 98.233(dd)(2).
- (iv) Total annual  $CH_4$  emissions, in metric tons  $CH_4$ , from drilling mud degassing, calculated from summing the annual  $CH_4$  emissions calculated from § 98.233(dd)(3)(iii)(E) and § 98.233(dd)(3)(iv)(C).

(ee) **Crankcase vents.** You must indicate whether your facility performs any crankcase venting from reciprocating internal combustion engines. For all reciprocating internal combustion engines with crankcase vents, you must report the information specified in paragraph (ee)(1) of this section for each well-pad site (for onshore petroleum and natural gas production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments). For each reciprocating internal combustion engine that you conduct measurements as specified in § 98.233(ee)(1), you must report the information specified in paragraph (ee)(2) of this section. For reciprocating internal combustion engines with  $CH_4$  emissions calculated as specified in § 98.233(ee)(2), you must report the information specified in paragraph (ee)(3) of this section for each well-pad site (for onshore petroleum and natural gas production), gathering and boosting site (for onshore petroleum and natural gas gathering and boosting), or facility (for all other applicable industry segments).

- (1) The information and number of reciprocating internal combustion engines with crankcase vents as specified in paragraphs (ee)(1)(i) through (v) of this section, as applicable. If a reciprocating internal combustion engine with crankcase vents was vented directly to the atmosphere for part of the year and routed to a flare during another part of the year, then include the engine in each of the applicable counts specified in paragraphs (ee)(1)(iii) and (iv) of this section.
  - (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) The total number of reciprocating internal combustion engines with crankcase vents.
  - (iii) The total number of reciprocating internal combustion engines with crankcase vents that operated and were vented directly to the atmosphere.
  - (iv) The total number of reciprocating internal combustion engines with crankcase vents that operated and were routed to a flare.
  - (v) The total number of reciprocating internal combustion engines with crankcase vents that were in a manifolded group containing a compressor vent source with emissions reported under paragraph (o) or (p) of this section.
- (2) Reciprocating internal combustion engines with crankcase vents that calculate emissions according to § 98.233(ee)(1) must report the information specified in paragraphs (ee)(2)(i) and (ii) of this section, as applicable.

- (i) For each measurement performed on a crankcase vent, report the information specified in paragraphs (ee)(2)(i)(A) through (F) of this section.
    - (A) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
    - (B) Unique name or ID for the reciprocating internal combustion engine.
    - (C) Measurement date.
    - (D) Measurement method. If emissions were not detected when using a screening method, report the screening method. If emissions were detected using a screening method, report only the method subsequently used to measure the volumetric emissions.
    - (E) Measured flow rate, in standard cubic feet per hour.
    - (F) If the measurement is for a manifolded group of crankcase vent sources, indicate the number of reciprocating internal compressor engines that were operating during measurement.
  - (ii) Annual CH<sub>4</sub> emissions from the reciprocating internal combustion engine crankcase vent, in metric tons CH<sub>4</sub>.
- (3) Reciprocating internal combustion engines with crankcase vents that calculate emissions according to § 98.233(ee)(2) must report the information specified in paragraphs (ee)(3)(i) through (iv) of this section.
- (i) Well-pad ID (for the onshore petroleum and natural gas production industry segment only) or gathering and boosting site ID (for the onshore petroleum and natural gas gathering and boosting industry segment only).
  - (ii) Total number of reciprocating internal combustion engines with crankcase vents that were operational at some point in the calendar year at the well-pad site, gathering and boosting site, or facility, as applicable.
  - (iii) Total time that the reciprocating internal combustion engines with crankcase venting were operational in the calendar year, in hours ("T" in equation W-46 to § 98.233).
  - (iv) Annual CH<sub>4</sub> emissions, in metric tons CH<sub>4</sub>, calculated according to § 98.233(ee)(2).

[79 FR 70411, Nov. 24, 2014, as amended at 80 FR 64291, Oct. 22, 2015; 81 FR 86515, Nov. 30, 2016; 89 FR 42289, 42293, May 14, 2024; 89 FR 71846, 71848, Sept. 4, 2024]

### § 98.237 Records that must be retained.

Monitoring Plans, as described in § 98.3(g)(5), must be completed by April 1, 2011. In addition to the information required by § 98.3(g), you must retain the following records:

- (a) Dates on which measurements were conducted.
- (b) Results of all emissions detected and measurements.
- (c) Calibration reports for detection and measurement instruments used.

- (d) Inputs and outputs of calculations or emissions computer model runs used for engineering estimation of emissions.
- (e) The records required under § 98.3(g)(2)(i) shall include an explanation of how company records, engineering estimation, or best available information are used to calculate each applicable parameter under this subpart.
- (f) For each time a missing data procedure was used, keep a record listing the emission source type, a description of the circumstance that resulted in the need to use missing data procedures, the missing data provisions in § 98.235 that apply, the calculation or analysis used to develop the substitute value, and the substitute value.
- (g) For each situation when you fail to fully conform with all cited provisions in either § 98.233(n)(1)(i) or (ii) for a period of 15 consecutive days and you utilized the Tier 3 default destruction and combustion efficiency values, you must document these periods when the non-conformance began, and the date when full conformance was re-established.

[75 FR 74488, Nov. 30, 2010, as amended at 76 FR 80590, Dec. 23, 2011; 79 FR 70424, Nov. 25, 2014; 89 FR 42321, May 14, 2024]

## § 98.238 Definitions.

Except as provided in this section, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Acid gas** means hydrogen sulfide (H<sub>2</sub>S) and/or carbon dioxide (CO<sub>2</sub>) contaminants that are separated from sour natural gas by an acid gas removal unit.

**Acid gas removal unit (AGR)** means a process unit that separates hydrogen sulfide and/or carbon dioxide from sour natural gas using liquid or solid absorbents or membrane separators.

**Acid gas removal unit (AGR) vent emissions** mean the acid gas separated from the acid gas absorbing medium (e.g., an amine solution) and released with methane and other light hydrocarbons to the atmosphere.

**Associated gas venting or flaring** means the venting or flaring of natural gas which originates at wellheads that also produce hydrocarbon liquids and occurs either in a discrete gaseous phase at the wellhead or is released from the liquid hydrocarbon phase by separation. This does not include venting or flaring resulting from activities that are reported elsewhere, including tank venting, well completions, and well workovers.

**Associated with a single well-pad** means associated with the hydrocarbon stream as produced from one or more wells located on that single well-pad. The association ends where the stream from a single well-pad is combined with streams from one or more additional single well-pads, where the point of combination is located off that single well-pad. Onshore production storage tanks on or associated with a single well-pad are considered a part of the onshore production facility.

**Atmospheric pressure storage tank** means a vessel (excluding sumps) operating at atmospheric pressure that is designed to contain an accumulation of crude oil, condensate, intermediate hydrocarbon liquids, or produced water and that is constructed entirely of non-earthen materials (e.g., wood, concrete, steel, plastic) that provide structural support. Atmospheric pressure storage tanks include both fixed roof tanks and floating roof tanks. Floating roof tanks include tanks with either an internal floating roof or an external floating roof.

**Automated liquids unloading** means an unloading that is performed without manual interference. Examples of automated liquids unloadings include a timing and/or pressure device used to optimize intermittent shut-in of the well before liquids choke off gas flow or to open and close valves, continually operating equipment that does not require presence of an operator such as rod pumping units, automated and unmanned plunger lifts, or other unloading activities that do not entail a physical presence at the well-pad.

**Basin** means geologic provinces as defined by the American Association of Petroleum Geologists (AAPG) Geologic Note: AAPG-CSD Geologic Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laure G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991) (incorporated by reference, see § 98.7) and the Alaska Geological Province Boundary Map, Compiled by the American Association of Petroleum Geologists Committee on Statistics of Drilling in Cooperation with the USGS, 1978 (incorporated by reference, see § 98.7).

**Centralized oil production site** means any permanent combination of one or more hydrocarbon liquids storage tanks located on one or more contiguous or adjacent properties that does not also contain a permanent combination of one or more compressors that are part of the onshore petroleum and natural gas gathering and boosting facility that gathers hydrocarbon liquids from multiple well-pads. A *centralized oil production site* is a type of gathering and boosting site for purposes of this subpart.

**Compressor** means any machine for raising the pressure of a natural gas or CO<sub>2</sub> by drawing in low pressure natural gas or CO<sub>2</sub> and discharging significantly higher pressure natural gas or CO<sub>2</sub>.

**Compressor mode** means the operational and pressurized status of a compressor. For both centrifugal compressors and reciprocating compressors, “mode” refers to either: Operating-mode, standby-pressurized-mode, or not-operating-depressurized-mode.

**Compressor source** means the source of certain venting or leaking emissions from a centrifugal or reciprocating compressor. For centrifugal compressors, “source” refers to blowdown valve leakage through the blowdown vent, unit isolation valve leakage through an open blowdown vent without blind flanges, wet seal oil degassing vents, and dry seal vents. For reciprocating compressors, “source” refers to blowdown valve leakage through the blowdown vent, unit isolation valve leakage through an open blowdown vent without blind flanges, and rod packing emissions.

**Condensate** means hydrocarbon and other liquid, including both water and hydrocarbon liquids, separated from natural gas that condenses due to changes in the temperature, pressure, or both, and remains liquid at storage conditions.

**Crankcase venting** means the process of venting or removing blow-by from the void spaces of an internal combustion engine outside of the combustion cylinders to prevent excessive pressure build-up within the engine. This does not include ingestive systems that vent blow-by into the engine where it is returned to the combustion process (e.g., closed crankcase ventilation system, closed breather system) or if the vent blow-by is routed to another closed vent system.

**Delineation well** means a well drilled in order to determine the boundary of a field or producing reservoir.

**Distribution pipeline** means a pipeline that is designated as such by the Pipeline and Hazardous Material Safety Administration (PHMSA) 49 CFR 192.3.

**Drilling mud** means a mixture of clays and additives with water, oil, or synthetic materials. While drilling, the drilling mud is continuously pumped through the drill string and out the bit to cool and lubricate the drill bit, and move cuttings through the wellbore to the surface.

*Drilling mud degassing* means the practice of safely removing pockets of free gas entrained in the drilling mud once it is outside of the wellbore.

*Enclosed combustion device* means a flare that uses a closed flame.

*Engineering estimation*, for purposes of subpart W, means an estimate of emissions based on engineering principles applied to measured and/or approximated physical parameters such as dimensions of containment, actual pressures, actual temperatures, and compositions.

*Enhanced oil recovery* (EOR) means the use of certain methods such as water flooding or gas injection into existing wells to increase the recovery of crude oil from a reservoir. In the context of this subpart, EOR applies to injection of critical phase or immiscible carbon dioxide into a crude oil reservoir to enhance the recovery of oil.

*Equivalent stratigraphic interval* means the depth of the same stratum of rock in the Earth's subsurface.

*External combustion* means fired combustion in which the flame and products of combustion are separated from contact with the process fluid to which the energy is delivered. Process fluids may be air, hot water, or hydrocarbons. External combustion equipment may include fired heaters, industrial boilers, and commercial and domestic combustion units.

*Facility with respect to natural gas distribution for purposes of reporting under this subpart and for the corresponding subpart A requirements*

means the collection of all distribution pipelines and metering-regulating stations that are operated by a Local Distribution Company (LDC) within a single state that is regulated as a separate operating company by a public utility commission or that are operated as an independent municipally-owned distribution system.

*Facility with respect to onshore petroleum and natural gas gathering and boosting for purposes of reporting under this subpart and for the corresponding subpart A requirements*

means all gathering pipelines and other equipment located along those pipelines that are under common ownership or common control by a gathering and boosting system owner or operator and that are located in a single hydrocarbon basin as defined in this section. Where a person owns or operates more than one gathering and boosting system in a basin (for example, separate gathering lines that are not connected), then all gathering and boosting equipment that the person owns or operates in the basin would be considered one facility. Any gathering and boosting equipment that is associated with a single gathering and boosting system, including leased, rented, or contracted activities, is considered to be under common control of the owner or operator of the gathering and boosting system that contains the pipeline. The facility does not include equipment and pipelines that are part of any other industry segment defined in this subpart.

*Facility with respect to onshore petroleum and natural gas production for purposes of reporting under this subpart and for the corresponding subpart A requirements*

means all petroleum or natural gas equipment on a single well-pad or associated with a single well-pad and CO<sub>2</sub> EOR operations that are under common ownership or common control including leased, rented, or contracted activities by an onshore petroleum and natural gas production owner or operator and that are located in a single hydrocarbon basin as defined in § 98.238. Where a person or entity owns or operates more than one well in a basin, then all onshore petroleum and natural gas production equipment associated with all wells that the person or entity owns or operates in the basin would be considered one facility.

*Facility with respect to the onshore natural gas transmission pipeline segment* means the total U.S. mileage of natural gas transmission pipelines, as defined in this section, owned and operated by an onshore natural gas transmission pipeline owner or operator as defined in this section. The facility does not include pipelines that are part of any other industry segment defined in this subpart.

*Farm Taps* are pressure regulation stations that deliver gas directly from transmission pipelines to generally rural customers. In some cases a nearby LDC may handle the billing of the gas to the customer(s).

*Field* means oil and gas fields identified in the United States as defined by the Energy Information Administration Oil and Gas Field Code Master List 2008, DOE/EIA 0370(08) (incorporated by reference, see § 98.7).

*Flare*, for the purposes of subpart W, means a combustion device, whether at ground level or elevated, that uses an open or closed flame to combust waste gases without energy recovery.

*Flare combustion efficiency* means the fraction of hydrocarbon gas, on a volume or mole basis, that is combusted at the flare burner tip.

*Flare stack emissions* means CO<sub>2</sub> in gas routed to a flare, CO<sub>2</sub> from partial combustion of hydrocarbons in gas routed to a flare, CH<sub>4</sub> emissions resulting from the incomplete combustion of hydrocarbons in gas routed to a flare, and N<sub>2</sub>O resulting from operation of a flare.

*Forced extraction of natural gas liquids* means removal of ethane or higher carbon number hydrocarbons existing in the vapor phase in natural gas, by removing ethane or heavier hydrocarbons derived from natural gas into natural gas liquids by means of a forced extraction process. Forced extraction processes include but are not limited to refrigeration, absorption (lean oil), cryogenic expander, and combinations of these processes. Forced extraction does not include in and of itself natural gas dehydration, the collection or gravity separation of water or hydrocarbon liquids from natural gas at ambient temperature or heated above ambient temperatures, the condensation of water or hydrocarbon liquids through passive reduction in pressure or temperature, a Joule-Thomson valve, a dew point depression valve, or an isolated or standalone Joule-Thomson skid.

*Gathering and boosting site* means a single gathering compressor station as defined in this section, centralized oil production site as defined in this section, gathering pipeline site as defined in this section, or other fence-line site within the onshore petroleum and natural gas gathering and boosting industry segment.

*Gathering and boosting system* means a single network of pipelines, compressors and process equipment, including equipment to perform natural gas compression, dehydration, and acid gas removal, that has one or more connection points to gas and oil production or one or more other gathering and boosting systems and a downstream endpoint, typically a gas processing plant, transmission pipeline, LDC pipeline, or other gathering and boosting system.

*Gathering and boosting system owner or operator* means any person that holds a contract in which they agree to transport petroleum or natural gas from one or more onshore petroleum and natural gas production wells or one or more other gathering and boosting systems to a downstream endpoint, typically a natural gas processing facility, another gathering and boosting system, a natural gas transmission pipeline, or a distribution pipeline, or any person responsible for custody of the petroleum or natural gas transported.

**Gathering compressor station** means any permanent combination of one or more compressors located on one or more contiguous or adjacent properties that are part of the onshore petroleum and natural gas gathering and boosting facility that move natural gas at increased pressure through gathering pipelines or into or out of storage. A *gathering compressor station* is a type of gathering and boosting site for purposes of this subpart.

**Gathering pipeline site** means all of the gathering pipelines within a single state. A *gathering pipeline site* is a type of gathering and boosting site for purposes of this subpart.

**Horizontal well** means a well bore that has a planned deviation from primarily vertical to a primarily horizontal inclination or declination tracking in parallel with and through the target formation.

**In vacuum service** means equipment operating at an internal pressure which is at least 5 kilopascals (kPa) (0.7 psia) below ambient pressure.

**Internal combustion** means the combustion of a fuel that occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine the expansion of the high-temperature and -pressure gases produced by combustion applies direct force to a component of the engine, such as pistons, turbine blades, or a nozzle. This force moves the component over a distance, generating useful mechanical energy. Internal combustion equipment may include gasoline and diesel industrial engines, natural gas-fired reciprocating engines, and gas turbines.

**Liquefied natural gas (LNG)** means natural gas (primarily methane) that has been liquefied by reducing its temperature to -260 degrees Fahrenheit at atmospheric pressure.

**LNG boil-off gas** means natural gas in the gaseous phase that vents from LNG storage tanks due to ambient heat leakage through the tank insulation and heat energy dissipated in the LNG by internal pumps.

**Manifolded compressor source** means a compressor source (as defined in this section) that is manifolded to a common vent that routes gas from multiple compressors.

**Manifolded group of compressor sources** means a collection of any combination of manifolded compressor sources (as defined in this section) that are manifolded to a common vent.

**Manual liquids unloading** means an unloading when field personnel attend to the well at the well-pad, for example to manually plunge a well at the site using a rig or other method, to open a valve to direct flow to an atmospheric tank to clear the well, or to manually shut-in the well to allow pressure to build in the well-bore. Manual unloadings may be performed on a routine schedule or on "as needed" basis.

**Meter/regulator run** means a series of components used in regulating pressure or metering natural gas flow, or both, in the natural gas distribution industry segment. At least one meter, at least one regulator, or any combination of both on a single run of piping is considered one meter/regulator run.

**Metering-regulating station** means a station that meters the flowrate, regulates the pressure, or both, of natural gas in a natural gas distribution facility. This does not include customer meters, customer regulators, or farm taps.

**Mud rate** means the pumping rate of the mud by the mud pumps, usually measured in gallons per minute (gpm).

**Natural gas** means a naturally occurring mixture or process derivative of hydrocarbon and non-hydrocarbon gases found in geologic formations beneath the earth's surface, of which its constituents include, but are not limited to, methane, heavier hydrocarbons and carbon dioxide. Natural gas may be field quality, pipeline quality, or process gas.



**Nitrogen removal unit** (NRU) means a process unit that separates nitrogen from natural gas using various separation processes (e.g., cryogenic units, membrane units).

**Nitrogen removal unit vent emissions** means the nitrogen gas separated from the natural gas and released with methane and other gases to the atmosphere.

**Offshore** means seaward of the terrestrial borders of the United States, including waters subject to the ebb and flow of the tide, as well as adjacent bays, lakes or other normally standing waters, and extending to the outer boundaries of the jurisdiction and control of the United States under the Outer Continental Shelf Lands Act.

**Onshore natural gas transmission pipeline owner or operator** means, for interstate pipelines, the person identified as the transmission pipeline owner or operator on the Certificate of Public Convenience and Necessity issued under 15 U.S.C. 717f, or, for intrastate pipelines, the person identified as the owner or operator on the transmission pipeline's Statement of Operating Conditions under section 311 of the Natural Gas Policy Act, or for pipelines that fall under the “Hinshaw Exemption” as referenced in section 1(c) of the Natural Gas Act, 15 U.S.C. 717-717 (w)(1994), the person identified as the owner or operator on blanket certificates issued under 18 CFR 284.224. If an intrastate pipeline is not subject to section 311 of the Natural Gas Policy Act (NGPA), the onshore natural gas transmission pipeline owner or operator is the person identified as the owner or operator on reports to the state regulatory body regulating rates and charges for the sale of natural gas to consumers.

**Onshore petroleum and natural gas production owner or operator** means the person or entity who holds the permit to operate petroleum and natural gas wells on the drilling permit or an operating permit where no drilling permit is issued, which operates an onshore petroleum and/or natural gas production facility (as described in § 98.230(a)(2). Where petroleum and natural gas wells operate without a drilling or operating permit, the person or entity that pays the State or Federal business income taxes is considered the owner or operator.

**Operating pressure** means the containment pressure that characterizes the normal state of gas or liquid inside a particular process, pipeline, vessel or tank.

**Other large release event** means any planned or unplanned uncontrolled release to the atmosphere of gas, liquids, or mixture thereof, from wells and/or other equipment that result in emissions for which there are no methodologies in § 98.233 other than under § 98.233(y) to appropriately estimate these emissions. **Other large release events** include, but are not limited to, well blowouts, well releases, pressure relief valve releases from process equipment other than hydrocarbon liquids storage tanks, storage tank cleaning and other maintenance activities, and releases that occur as a result of an accident, equipment rupture, fire, or explosion. **Other large release events** also include failure of equipment or equipment components such that a single equipment leak or release has emissions that exceed the emissions calculated for that source using applicable methods in § 98.233(a) through (h), (j) through (s), (w), (x), (dd), or (ee) by the threshold in § 98.233(y)(1)(ii). **Other large release events** do not include blowdowns for which emissions are calculated according to the provisions in § 98.233(i).

**Pressure groups** as applicable to each sub-basin are defined as follows: Less than or equal to 25 psig; greater than 25 psig and less than or equal to 60 psig; greater than 60 psig and less than or equal to 110 psig; greater than 110 psig and less than or equal to 200 psig; and greater than 200 psig. The pressure in the context of pressure groups is either the well shut-in pressure; well casing pressure; or you may use the casing-to-tubing pressure of one well from the same sub-basin multiplied by the tubing pressure for each well in the sub-basin.

**Produced water** means the water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and can include formation water, injection water, and any chemicals added downhole or during the oil/water separation process.

**Pump** means a device used to raise pressure, drive, or increase flow of liquid streams in closed or open conduits.

**Pump seals** means any seal on a pump drive shaft used to keep methane and/or carbon dioxide containing light liquids from escaping the inside of a pump case to the atmosphere.

**Pump seal emissions** means hydrocarbon gas released from the seal face between the pump internal chamber and the atmosphere.

**Reduced emissions completion** means a well completion following hydraulic fracturing where gas flowback emissions from the gas outlet of the separator that are otherwise vented are captured, cleaned, and routed to the flow line or collection system, re-injected into the well or another well, used as an on-site fuel source, or used for other useful purpose that a purchased fuel or raw material would serve, with de minimis direct venting to the atmosphere. Short periods of flaring during a reduced emissions completion may occur.

**Reduced emissions workover** means a well workover with hydraulic fracturing (i.e., refracturing) where gas flowback emissions from the gas outlet of the separator that are otherwise vented are captured, cleaned, and routed to the flow line or collection system, re-injected into the well or another well, used as an on-site fuel source, or used for other useful purpose that a purchased fuel or raw material would serve, with de minimis direct venting to the atmosphere. Short periods of flaring during a reduced emissions workover may occur.

**Reservoir** means a porous and permeable underground natural formation containing significant quantities of hydrocarbon liquids and/or gases.

**Residue Gas** and **Residue Gas Compression** mean, respectively, production lease natural gas from which gas liquid products and, in some cases, non-hydrocarbon components have been extracted such that it meets the specifications set by a pipeline transmission company, and/or a distribution company; and the compressors operated by the processing facility, whether inside the processing facility boundary fence or outside the fence-line, that deliver the residue gas from the processing facility to a transmission pipeline.

**Routed to combustion** means, for onshore petroleum and natural gas production facilities, natural gas distribution facilities, and onshore petroleum and natural gas gathering and boosting facilities, that emissions are routed to stationary or portable fuel combustion equipment specified in § 98.232(c)(22), (i)(7), or (j)(12), as applicable. For all other industry segments in this subpart, *routed to combustion* means that emissions are routed to a stationary fuel combustion unit subject to subpart C of this part (General Stationary Fuel Combustion Sources).

**Separator** means a vessel in which streams of multiple phases are gravity separated into individual streams of single phase.

**Sub-basin category, for onshore natural gas production**, means a subdivision of a basin into the unique combination of wells with the surface coordinates within the boundaries of an individual county and subsurface completion in one or more of each of the following five formation types: Oil, high permeability gas, shale gas, coal seam, or other tight gas reservoir rock. The distinction between high permeability gas and tight gas reservoirs shall be designated as follows: High permeability gas reservoirs with >0.1 millidarcy permeability, and tight gas reservoirs with ≤0.1 millidarcy permeability. Permeability for a

reservoir type shall be determined by engineering estimate. Wells that produce only from high permeability gas, shale gas, coal seam, or other tight gas reservoir rock are considered gas wells; gas wells producing from more than one of these formation types shall be classified into only one type based on the formation with the most contribution to production as determined by engineering knowledge. All wells that produce hydrocarbon liquids (with or without gas) and do not meet the definition of a gas well in this sub-basin category definition are considered to be in the oil formation. All emission sources that handle condensate from gas wells in high permeability gas, shale gas, or tight gas reservoir rock formations are considered to be in the formation that the gas well belongs to and not in the oil formation.

**Target hydrocarbon-bearing stratigraphic formation** means the stratigraphic interval intended to be the primary hydrocarbon producing formation.

**Transmission company interconnect M&R station** means a metering and pressure regulating stations with an inlet pressure above 100 psig located at a point of transmission pipeline to transmission pipeline interconnect.

**Transmission-distribution (T-D) transfer station** means a metering-regulating station where a local distribution company takes part or all of the natural gas from a transmission pipeline and puts it into a distribution pipeline.

**Transmission pipeline** means a Federal Energy Regulatory Commission rate-regulated Interstate pipeline, a state rate-regulated Intrastate pipeline, or a pipeline that falls under the “Hinshaw Exemption” as referenced in section 1(c) of the Natural Gas Act, 15 U.S.C. 717-717 (w)(1994).

**Tubing diameter groups** are defined as follows: Outer diameter less than or equal to 1 inch; outer diameter greater than 1 inch and less than 2.375 inch; and outer diameter greater than or equal to 2.375 inch.

**Tubing systems** means piping equal to or less than one half inch diameter as per nominal pipe size.

**Turbine meter** means a flow meter in which a gas or liquid flow rate through the calibrated tube spins a turbine from which the spin rate is detected and calibrated to measure the fluid flow rate.

**Vented emissions** means intentional or designed releases of CH<sub>4</sub> or CO<sub>2</sub> containing natural gas or hydrocarbon gas (not including stationary combustion flue gas), including process designed flow to the atmosphere through seals or vent pipes, equipment blowdown for maintenance, and direct venting of gas used to power equipment (such as pneumatic devices).

**Vertical well** means a well bore that is primarily vertical but has some unintentional deviation or one or more intentional deviations to enter one or more subsurface targets that are off-set horizontally from the surface location, intercepting the targets either vertically or at an angle.

**Well blowout** means a complete loss of well control for a long duration of time resulting in an emissions release.

**Well identification (ID) number** means the unique and permanent identification number assigned to a petroleum or natural gas well. If the well has been assigned a US Well Number, the well ID number required in this subpart is the US Well Number. If a US Well Number has not been assigned to the well, the well ID number is the identifier established by the well's permitting authority.

**Well-pad site** means all equipment on or associated with a single well-pad. Specifically, the well-pad site includes all equipment on a single well-pad plus all equipment associated with that single well-pad.

**Well release** means a short duration of uncontrolled emissions release from a well followed by a period of controlled emissions release in which control techniques were successfully implemented.

**Well testing venting and flaring** means venting and/or flaring of natural gas at the time the production rate of a well is determined for regulatory, commercial, or technical purposes. If well testing is conducted immediately after well completion or workover, then it is considered part of well completion or workover.

**Wildcat well** means a well outside known fields or the first well drilled in an oil or gas field where no other oil and gas production exists.

[75 FR 74488, Nov. 30, 2010, as amended at 76 FR 80590, Dec. 23, 2011; 79 FR 63794, Oct. 24, 2014; 79 FR 70424, Nov. 25, 2014; 80 FR 64296, Oct. 22, 2015; 89 FR 42321-22, May 14, 2024]

**Table W-1 to Subpart W of Part 98—Default Whole Gas Population Emission Factors**

| Industry segment                                                                                 | Source type/component                                     | Emission factor<br>(scf whole gas/<br>hour/unit) |
|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------|
| POPULATION EMISSION FACTORS—PNEUMATIC DEVICE VENTS AND PNEUMATIC PUMPS, GAS SERVICE <sup>1</sup> |                                                           |                                                  |
| • Onshore petroleum and natural gas production                                                   | Continuous Low Bleed Pneumatic Device Vents <sup>2</sup>  | 6.8                                              |
|                                                                                                  | Continuous High Bleed Pneumatic Device Vents <sup>2</sup> | 21                                               |
|                                                                                                  | Intermittent Bleed Pneumatic Device Vents <sup>2</sup>    | 8.8                                              |
|                                                                                                  | Pneumatic Pumps <sup>3</sup>                              | 13.3                                             |
| • Onshore natural gas processing                                                                 | Continuous Low Bleed Pneumatic Device Vents <sup>2</sup>  | 6.8                                              |
| • Onshore natural gas transmission compression                                                   | Continuous High Bleed Pneumatic Device Vents <sup>2</sup> | 30                                               |
| • Underground natural gas storage                                                                | Intermittent Bleed Pneumatic Device Vents <sup>2</sup>    | 2.3                                              |
| • Natural gas distribution                                                                       |                                                           |                                                  |
| POPULATION EMISSION FACTORS—MAJOR EQUIPMENT, GAS SERVICE <sup>1</sup>                            |                                                           |                                                  |
| • Onshore petroleum and natural gas production                                                   | Wellhead                                                  | 8.87                                             |
| • Onshore petroleum and natural gas gathering and boosting                                       | Separator                                                 | 9.65                                             |
|                                                                                                  | Meters/Piping                                             | 7.04                                             |
|                                                                                                  | Compressor                                                | 13.8                                             |

<sup>1</sup> For multi-phase flow that includes gas, use the gas service emission factors.

<sup>2</sup> Emission factor is in units of “scf whole gas/hour/device.”

<sup>3</sup> Emission factor is in units of “scf whole gas/hour/pump.”

<sup>4</sup> Emission factors are in units of “scf whole gas/hour/mile of pipeline.”

| Industry segment                                                               | Source type/component | Emission factor<br>(scf whole gas/<br>hour/unit) |
|--------------------------------------------------------------------------------|-----------------------|--------------------------------------------------|
|                                                                                | Dehydrator            | 8.09                                             |
|                                                                                | Heater                | 5.22                                             |
|                                                                                | Storage Vessel        | 1.83                                             |
| POPULATION EMISSION FACTORS—MAJOR EQUIPMENT, CRUDE SERVICE                     |                       |                                                  |
| Onshore petroleum and natural gas production                                   | Wellhead              | 4.13                                             |
|                                                                                | Separator             | 4.77                                             |
|                                                                                | Meters/Piping         | 12.4                                             |
|                                                                                | Compressor            | 13.8                                             |
|                                                                                | Dehydrator            | 8.09                                             |
|                                                                                | Heater                | 3.2                                              |
|                                                                                | Storage Vessel        | 1.91                                             |
| POPULATION EMISSION FACTORS—GATHERING PIPELINES, BY MATERIAL TYPE <sup>4</sup> |                       |                                                  |
| Onshore petroleum and natural gas gathering and boosting                       | Protected Steel       | 0.93                                             |
|                                                                                | Unprotected Steel     | 8.2                                              |
|                                                                                | Plastic/Composite     | 0.28                                             |
|                                                                                | Cast Iron             | 8.4                                              |

<sup>1</sup> For multi-phase flow that includes gas, use the gas service emission factors.

<sup>2</sup> Emission factor is in units of “scf whole gas/hour/device.”

<sup>3</sup> Emission factor is in units of “scf whole gas/hour/pump.”

<sup>4</sup> Emission factors are in units of “scf whole gas/hour/mile of pipeline.”

[89 FR 42323, May 14, 2024]

**Table W-2 to Subpart W of Part 98—Default Whole Gas Leaker Emission Factors**

| Equipment components                                                                                                                                          | Emission factor (scf whole gas/hour/component)                  |                                                                  |                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------|
|                                                                                                                                                               | If you survey using Method 21 as specified in § 98.234(a)(2)(i) | If you survey using Method 21 as specified in § 98.234(a)(2)(ii) | If you survey using any of the methods in § 98.234(a)(1), (3), or (5) |
| LEAKER EMISSION FACTORS—ONSHORE PETROLEUM AND NATURAL GAS PRODUCTION AND ONSHORE PETROLEUM AND NATURAL GAS GATHERING AND BOOSTING—ALL COMPONENTS, GAS SERVICE |                                                                 |                                                                  |                                                                       |
| Valve                                                                                                                                                         | 9.6                                                             | 5.5                                                              | 16                                                                    |
| Flange                                                                                                                                                        | 6.9                                                             | 4.0                                                              | 11                                                                    |
| Connector (other)                                                                                                                                             | 4.9                                                             | 2.8                                                              | 7.9                                                                   |
| Open-Ended Line <sup>1</sup>                                                                                                                                  | 6.3                                                             | 3.6                                                              | 10                                                                    |
| Pressure Relief Valve                                                                                                                                         | 7.8                                                             | 4.5                                                              | 13                                                                    |
| Pump Seal                                                                                                                                                     | 14                                                              | 8.3                                                              | 23                                                                    |
| Other <sup>2</sup>                                                                                                                                            | 9.1                                                             | 5.3                                                              | 15                                                                    |
| LEAKER EMISSION FACTORS—ONSHORE PETROLEUM AND NATURAL GAS PRODUCTION—ALL COMPONENTS, OIL SERVICE                                                              |                                                                 |                                                                  |                                                                       |
| Valve                                                                                                                                                         | 5.6                                                             | 3.3                                                              | 9.2                                                                   |
| Flange                                                                                                                                                        | 2.7                                                             | 1.6                                                              | 4.4                                                                   |
| Connector (other)                                                                                                                                             | 5.6                                                             | 3.2                                                              | 9.1                                                                   |
| Open-Ended Line                                                                                                                                               | 1.6                                                             | 0.93                                                             | 2.6                                                                   |
| Pump <sup>3</sup>                                                                                                                                             | 3.7                                                             | 2.2                                                              | 6.0                                                                   |
| Other <sup>2</sup>                                                                                                                                            | 2.2                                                             | 1.0                                                              | 2.9                                                                   |

<sup>1</sup> The open-ended lines component type includes blowdown valve and isolation valve leaks emitted through the blowdown vent stack for centrifugal and reciprocating compressors when using the population emission factor approach as specified in § 98.233(o)(10)(iv) or (p)(10)(iv).

<sup>2</sup> “Others” category includes any equipment leak emission point not specifically listed in this table, as specified in § 98.232(c)(21) and (j)(10).

<sup>3</sup> The pumps component type in oil service includes agitator seals.

[89 FR 42324, May 14, 2024]

**Table W-3 to Subpart W of Part 98—Default Total Hydrocarbon Population Emission Factors**

| Industry segment                                           | Source type/component | Emission factor<br>(scf total hydrocarbon/<br>hour/component) |
|------------------------------------------------------------|-----------------------|---------------------------------------------------------------|
| POPULATION EMISSION FACTORS—STORAGE WELLHEADS, GAS SERVICE |                       |                                                               |
| Underground natural gas storage                            | Connector             | 0.01                                                          |
|                                                            | Valve                 | 0.1                                                           |
|                                                            | Pressure Relief Valve | 0.17                                                          |
|                                                            | Open-Ended Line       | 0.03                                                          |

[89 FR 42325, May 14, 2024]

**Table W-4 to Subpart W of Part 98—Default Total Hydrocarbon Leaker Emission Factors**

| Equipment components                                                                                                                           | Emission factor<br>(scf total hydrocarbon/hour/component)             |                                                                        |                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|                                                                                                                                                | If you survey using<br>Method 21 as specified in<br>§ 98.234(a)(2)(i) | If you survey using<br>Method 21 as specified in<br>§ 98.234(a)(2)(ii) | If you survey using any of<br>the methods in §<br>98.234(a)(1), (3), or (5) |
| LEAKER EMISSION FACTORS—ONSHORE NATURAL GAS PROCESSING, ONSHORE NATURAL GAS TRANSMISSION<br>COMPRESSION—COMPRESSOR COMPONENTS, GAS SERVICE     |                                                                       |                                                                        |                                                                             |
| Valve <sup>1</sup>                                                                                                                             | 14.84                                                                 | 9.51                                                                   | 24.2                                                                        |
| Connector                                                                                                                                      | 5.59                                                                  | 3.58                                                                   | 9.13                                                                        |
| Open-Ended<br>Line                                                                                                                             | 17.27                                                                 | 11.07                                                                  | 28.2                                                                        |
| Pressure<br>Relief Valve                                                                                                                       | 39.66                                                                 | 25.42                                                                  | 64.8                                                                        |
| Meter                                                                                                                                          | 19.33                                                                 | 12.39                                                                  | 31.6                                                                        |
| Other <sup>2</sup>                                                                                                                             | 4.1                                                                   | 2.63                                                                   | 6.70                                                                        |
| LEAKER EMISSION FACTORS—ONSHORE NATURAL GAS PROCESSING, ONSHORE NATURAL GAS TRANSMISSION<br>COMPRESSION—NON-COMPRESSOR COMPONENTS, GAS SERVICE |                                                                       |                                                                        |                                                                             |
| Valve <sup>1</sup>                                                                                                                             | 6.42                                                                  | 4.12                                                                   | 10.5                                                                        |
| Connector                                                                                                                                      | 5.71                                                                  | 3.66                                                                   | 9.3                                                                         |

<sup>1</sup> Valves include control valves, block valves and regulator valves.

<sup>2</sup> Other includes any potential equipment leak emission point in gas service that is not specifically listed in this table, as specified in § 98.232(d)(7) for onshore natural gas processing, § 98.232(e)(8) for onshore natural gas transmission compression, and as specified in § 98.232(f)(6) and (8) for underground natural gas storage.

| Equipment components                                                                   | Emission factor<br>(scf total hydrocarbon/hour/component)             |                                                                        |                                                                             |
|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|                                                                                        | If you survey using<br>Method 21 as specified in<br>§ 98.234(a)(2)(i) | If you survey using<br>Method 21 as specified in<br>§ 98.234(a)(2)(ii) | If you survey using any of<br>the methods in §<br>98.234(a)(1), (3), or (5) |
| Open-Ended Line                                                                        | 11.27                                                                 | 7.22                                                                   | 18.4                                                                        |
| Pressure Relief Valve                                                                  | 2.01                                                                  | 1.29                                                                   | 3.28                                                                        |
| Meter                                                                                  | 2.93                                                                  | 1.88                                                                   | 4.79                                                                        |
| Other <sup>2</sup>                                                                     | 4.1                                                                   | 2.63                                                                   | 6.70                                                                        |
| LEAKER EMISSION FACTORS—UNDERGROUND NATURAL GAS STORAGE—STORAGE STATION, GAS SERVICE   |                                                                       |                                                                        |                                                                             |
| Valve <sup>1</sup>                                                                     | 14.84                                                                 | 9.51                                                                   | 24.2                                                                        |
| Connector (other)                                                                      | 5.59                                                                  | 3.58                                                                   | 9.13                                                                        |
| Open-Ended Line                                                                        | 17.27                                                                 | 11.07                                                                  | 28.2                                                                        |
| Pressure Relief Valve                                                                  | 39.66                                                                 | 25.42                                                                  | 64.8                                                                        |
| Meter and Instrument                                                                   | 19.33                                                                 | 12.39                                                                  | 31.6                                                                        |
| Other <sup>2</sup>                                                                     | 4.1                                                                   | 2.63                                                                   | 6.70                                                                        |
| LEAKER EMISSION FACTORS—UNDERGROUND NATURAL GAS STORAGE—STORAGE WELLHEADS, GAS SERVICE |                                                                       |                                                                        |                                                                             |
| Valve <sup>1</sup>                                                                     | 4.5                                                                   | 3.2                                                                    | 7.35                                                                        |
| Connector (other than flanges)                                                         | 1.2                                                                   | 0.7                                                                    | 1.96                                                                        |
| Flange                                                                                 | 3.8                                                                   | 2.0                                                                    | 6.21                                                                        |
| Open-Ended Line                                                                        | 2.5                                                                   | 1.7                                                                    | 4.08                                                                        |
| Pressure Relief Valve                                                                  | 4.1                                                                   | 2.5                                                                    | 6.70                                                                        |
| Other <sup>2</sup>                                                                     | 4.1                                                                   | 2.5                                                                    | 6.70                                                                        |

<sup>1</sup> Valves include control valves, block valves and regulator valves.

<sup>2</sup> Other includes any potential equipment leak emission point in gas service that is not specifically listed in this table, as specified in § 98.232(d)(7) for onshore natural gas processing, § 98.232(e)(8) for onshore natural gas transmission compression, and as specified in § 98.232(f)(6) and (8) for underground natural gas storage.

[89 FR 42325, May 14, 2024]



**Table W-5 to Subpart W of Part 98—Default Methane Population Emission Factors**

| Industry segment                                                                                                                                                                            | Source type/component                         | Emission factor<br>(scf methane/<br>hour/<br>component) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------|
| POPULATION EMISSION FACTORS—LNG STORAGE COMPRESSOR, GAS SERVICE                                                                                                                             |                                               |                                                         |
| LNG storage                                                                                                                                                                                 | Vapor Recovery Compressor <sup>1</sup>        | 4.17                                                    |
| LNG import and export equipment                                                                                                                                                             |                                               |                                                         |
| POPULATION EMISSION FACTORS—BELOW GRADE TRANSMISSION-DISTRIBUTION TRANSFER STATION COMPONENTS AND BELOW GRADE METERING-REGULATING STATION <sup>2</sup> COMPONENTS, GAS SERVICE <sup>3</sup> |                                               |                                                         |
| Natural gas distribution                                                                                                                                                                    | Below Grade T-D Transfer Station              | 0.30                                                    |
|                                                                                                                                                                                             | Below Grade M&R Station                       | 0.30                                                    |
| POPULATION EMISSION FACTORS—DISTRIBUTION MAINS, GAS SERVICE <sup>4</sup>                                                                                                                    |                                               |                                                         |
| Natural gas distribution                                                                                                                                                                    | Unprotected Steel                             | 5.1                                                     |
|                                                                                                                                                                                             | Protected Steel                               | 0.57                                                    |
|                                                                                                                                                                                             | Plastic                                       | 0.17                                                    |
|                                                                                                                                                                                             | Cast Iron                                     | 6.9                                                     |
| POPULATION EMISSION FACTORS—DISTRIBUTION SERVICES, GAS SERVICE <sup>5</sup>                                                                                                                 |                                               |                                                         |
| Natural gas distribution                                                                                                                                                                    | Unprotected Steel                             | 0.086                                                   |
|                                                                                                                                                                                             | Protected Steel                               | 0.0077                                                  |
|                                                                                                                                                                                             | Plastic                                       | 0.0016                                                  |
|                                                                                                                                                                                             | Copper                                        | 0.03                                                    |
| POPULATION EMISSION FACTORS—INTERCONNECT, DIRECT SALE, OR FARM TAP STATIONS <sup>2 3</sup>                                                                                                  |                                               |                                                         |
| Onshore natural gas transmission pipeline                                                                                                                                                   | Transmission Company Interconnect M&R Station | 166                                                     |
|                                                                                                                                                                                             | Direct Sale or Farm Tap Station               | 1.3                                                     |
| POPULATION EMISSION FACTORS—TRANSMISSION PIPELINES, GAS SERVICE <sup>4</sup>                                                                                                                |                                               |                                                         |
| Onshore natural gas transmission pipeline                                                                                                                                                   | Unprotected Steel                             | 0.74                                                    |
|                                                                                                                                                                                             | Protected Steel                               | 0.041                                                   |
|                                                                                                                                                                                             | Plastic                                       | 0.061                                                   |
|                                                                                                                                                                                             | Cast Iron                                     | 27                                                      |

<sup>1</sup> Emission Factor is in units of “scf methane/hour/compressor.”

<sup>2</sup> Excluding customer meters.

<sup>3</sup> Emission Factor is in units of “scf methane/hour/station.”

<sup>4</sup> Emission Factor is in units of “scf methane/hour/mile.”

<sup>5</sup> Emission Factor is in units of “scf methane/hour/number of services.”

**Table W-6 to Subpart W of Part 98—Default Methane Leaker Emission Factors**

| Equipment components                                                                                                             | Emission factor (scf methane/hour/component)                    |                                                                  |                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------|
|                                                                                                                                  | If you survey using Method 21 as specified in § 98.234(a)(2)(i) | If you survey using Method 21 as specified in § 98.234(a)(2)(ii) | If you survey using any of the methods in § 98.234(a)(1), (3), or (5) |
| LEAKER EMISSION FACTORS—LNG STORAGE AND LNG IMPORT AND EXPORT EQUIPMENT—STORAGE COMPONENTS AND TERMINALS COMPONENTS, LNG SERVICE |                                                                 |                                                                  |                                                                       |
| Valve                                                                                                                            | 1.19                                                            | 0.23                                                             | 1.94                                                                  |
| Pump Seal                                                                                                                        | 4.00                                                            | 0.73                                                             | 6.54                                                                  |
| Connector                                                                                                                        | 0.34                                                            | 0.11                                                             | 0.56                                                                  |
| Other <sup>1</sup>                                                                                                               | 1.77                                                            | 0.99                                                             | 2.9                                                                   |
| LEAKER EMISSION FACTORS—LNG STORAGE AND LNG IMPORT AND EXPORT EQUIPMENT—STORAGE COMPONENTS AND TERMINALS COMPONENTS, GAS SERVICE |                                                                 |                                                                  |                                                                       |
| Valve <sup>2</sup>                                                                                                               | 14.84                                                           | 9.51                                                             | 24.2                                                                  |
| Connector                                                                                                                        | 5.59                                                            | 3.58                                                             | 9.13                                                                  |
| Open-Ended Line                                                                                                                  | 17.27                                                           | 11.07                                                            | 28.2                                                                  |
| Pressure Relief Valve                                                                                                            | 39.66                                                           | 25.42                                                            | 64.8                                                                  |
| Meter and Instrument                                                                                                             | 19.33                                                           | 12.39                                                            | 31.6                                                                  |
| Other <sup>3</sup>                                                                                                               | 4.1                                                             | 2.63                                                             | 6.70                                                                  |
| LEAKER EMISSION FACTORS—NATURAL GAS DISTRIBUTION—TRANSMISSION-DISTRIBUTION TRANSFER STATION <sup>4</sup> COMPONENTS, GAS SERVICE |                                                                 |                                                                  |                                                                       |
| Connector                                                                                                                        | 1.69                                                            |                                                                  | 2.76                                                                  |
| Block Valve                                                                                                                      | 0.557                                                           |                                                                  | 0.91                                                                  |
| Control Valve                                                                                                                    | 9.34                                                            |                                                                  | 15.3                                                                  |
| Pressure Relief Valve                                                                                                            | 0.27                                                            |                                                                  | 0.44                                                                  |
| Orifice Meter                                                                                                                    | 0.212                                                           |                                                                  | 0.35                                                                  |

<sup>1</sup> “Other” equipment type for components in LNG service should be applied for any equipment type other than connectors, pumps, or valves.

<sup>2</sup> Valves include control valves, block valves and regulator valves.

<sup>3</sup> “Other” equipment type for components in gas service should be applied for any equipment type other than valves, connectors, flanges, open-ended lines, pressure relief valves, and meters and instruments, as specified in § 98.232(g)(6) and (7) and § 98.232(h)(7) and (8).

<sup>4</sup> Excluding customer meters.

| Equipment components | Emission factor (scf methane/hour/component)                    |                                                                  |                                                                       |
|----------------------|-----------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------|
|                      | If you survey using Method 21 as specified in § 98.234(a)(2)(i) | If you survey using Method 21 as specified in § 98.234(a)(2)(ii) | If you survey using any of the methods in § 98.234(a)(1), (3), or (5) |
| Regulator            | 0.772                                                           |                                                                  | 1.26                                                                  |
| Open-ended Line      | 26.131                                                          |                                                                  | 42.7                                                                  |

<sup>1</sup> “Other” equipment type for components in LNG service should be applied for any equipment type other than connectors, pumps, or valves.

<sup>2</sup> Valves include control valves, block valves and regulator valves.

<sup>3</sup> “Other” equipment type for components in gas service should be applied for any equipment type other than valves, connectors, flanges, open-ended lines, pressure relief valves, and meters and instruments, as specified in § 98.232(g)(6) and (7) and § 98.232(h)(7) and (8).

<sup>4</sup> Excluding customer meters.

[89 FR 42327, May 14, 2024]

Table W-7 to Subpart W of Part 98—Default Methane Emission Factors for Internal Combustion Equipment

| Internal combustion equipment type       | Emission factor (kg CH <sub>4</sub> /mmBtu) |
|------------------------------------------|---------------------------------------------|
| Reciprocating Engine, 2-stroke lean-burn | 0.658                                       |
| Reciprocating Engine, 4-stroke lean-burn | 0.522                                       |
| Reciprocating Engine, 4-stroke rich-burn | 0.045                                       |
| Gas Turbine                              | 0.004                                       |

[89 FR 42327, May 14, 2024]

Subpart X—Petrochemical Production

§ 98.240 Definition of the source category.

- (a) The petrochemical production source category consists of processes as described in paragraphs (a)(1) and (2) of this section.

- (1) The petrochemical production source category consists of all processes that produce acrylonitrile, carbon black, ethylene, ethylene dichloride, ethylene oxide, or methanol, as either an intermediate in the on-site production of other chemicals or as an end product for sale or shipment off site, except as specified in paragraphs (b) through (g) of this section.
  - (2) When ethylene dichloride and vinyl chloride monomer are produced in an integrated process, you may consider the entire integrated process to be the petrochemical process for the purpose of complying with the mass balance option in § 98.243(c). If you elect to consider the integrated process to be the petrochemical process, then the mass balance must be performed over the entire integrated process.
- (b) A process that produces a petrochemical as a byproduct is not part of the petrochemical production source category.
  - (c) A facility that makes methanol, hydrogen, and/or ammonia from synthesis gas is part of the petrochemical source category if the annual mass of methanol produced exceeds the individual annual mass production levels of both hydrogen recovered as product and ammonia. The facility is part of subpart P of this part (Hydrogen Production) if the annual mass of hydrogen recovered as product exceeds the individual annual mass production levels of both methanol and ammonia. The facility is part of subpart G of this part (Ammonia Manufacturing) if the annual mass of ammonia produced exceeds the individual annual mass production levels of both hydrogen recovered as product and methanol.
  - (d) A direct chlorination process that is operated independently of an oxychlorination process to produce ethylene dichloride is not part of the petrochemical production source category.
  - (e) A process that produces bone black is not part of the petrochemical source category.
  - (f) A process that produces a petrochemical from bio-based feedstock is not part of the petrochemical production source category.
  - (g) A process that solely distills or recycles waste solvent that contains a petrochemical is not part of the petrochemical production source category.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79157, Dec. 17, 2010; 76 FR 80590, Dec. 23, 2011; 81 FR 89260, Dec. 9, 2016]

### § 98.241 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a petrochemical process as specified in § 98.240, and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.242 GHGs to report.

You must report the information in paragraphs (a) through (c) of this section:

- (a) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O process emissions from each petrochemical process unit. Process emissions include CO<sub>2</sub> generated by reaction in the process and by combustion of process off-gas in stationary combustion units and flares.

- (1) If you comply with § 98.243(b) or (d), report under this subpart the calculated CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions for each stationary combustion source and flare that burns any amount of petrochemical process off-gas. If you comply with § 98.243(b), also report under this subpart the measured CO<sub>2</sub> emissions from process vents routed to stacks that are not associated with stationary combustion units.
- (2) If you comply with § 98.243(c), report under this subpart the calculated CO<sub>2</sub> emissions for each petrochemical process unit.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions from stationary combustion units.
  - (1) If you comply with § 98.243(b) or (d), report these emissions from stationary combustion units that are associated with petrochemical process units and burn only supplemental fuel under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
  - (2) If you comply with § 98.243(c), report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C for all fuels, except emissions from burning petrochemical process off-gas in any combustion unit, including units that are not part of the petrochemical process unit, are not to be reported under subpart C of this part. Determine the applicable Tier in subpart C of this part (General Stationary Fuel Combustion Sources) based on the maximum rated heat input capacity of the stationary combustion source.
- (c) CO<sub>2</sub> captured. You must report the mass of CO<sub>2</sub> captured under, subpart PP of this part (Suppliers of Carbon Dioxide (CO<sub>2</sub>)) by following the requirements of subpart PP.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79157, Dec. 17, 2010; 78 FR 71960, Nov. 29, 2013]

### § 98.243 Calculating GHG emissions.

- (a) If you route all process vent emissions and emissions from combustion of process off-gas to one or more stacks and use CEMS on each stack to measure CO<sub>2</sub> emissions (except flare stacks), then you must determine process-based GHG emissions in accordance with paragraph (b) of this section. Otherwise, determine process-based GHG emissions in accordance with the procedures specified in paragraph (c) or (d) of this section.
- (b) **Continuous emission monitoring system (CEMS).** Route all process vent emissions and emissions from stationary combustion units that burn any amount of process off-gas to one or more stacks and determine GHG emissions as specified in paragraphs (b)(1) through (3) of this section.
  - (1) Determine CO<sub>2</sub> emissions from each stack (except flare stacks) according to the Tier 4 Calculation Methodology requirements in subpart C of this part.
  - (2) For each stack (except flare stacks) that includes emissions from combustion of petrochemical process off-gas, calculate CH<sub>4</sub> and N<sub>2</sub>O emissions in accordance with subpart C of this part (use Equation C-10 and the “fuel gas” emission factors in Table C-2 of subpart C of this part).
  - (3) For each flare, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions using the methodology specified in § 98.253(b).
- (c) **Mass balance for each petrochemical process unit.** Calculate the emissions of CO<sub>2</sub> from each process unit, for each calendar month as described in paragraphs (c)(1) through (c)(5) of this section.

- (1) For each gaseous and liquid feedstock and product, measure the volume or mass used or produced each calendar month with a flow meter by following the procedures specified in § 98.244(b)(2). Alternatively, for liquids, you may calculate the volume used or collected in each month based on measurements of the liquid level in a storage tank at least once per month (and just prior to each change in direction of the level of the liquid) following the procedures specified in § 98.244(b)(3). Fuels used for combustion purposes are not considered to be feedstocks.
- (2) For each solid feedstock and product, measure the mass used or produced each calendar month by following the procedures specified in § 98.244(b)(1).
- (3) Collect a sample of each feedstock and product at least once per month and determine the molecular weight (for gaseous materials when the quantity is measured in scf) and carbon content of each sample according to the procedures of § 98.244(b)(4). If multiple valid molecular weight or carbon content measurements are made during the monthly measurement period, average them arithmetically. However, if a particular liquid or solid feedstock is delivered in lots, and if multiple deliveries of the same feedstock are received from the same supply source in a given calendar month, only one representative sample is required. Alternatively, you may use the results of analyses conducted by a feedstock supplier, or product customer, provided the sampling and analysis is conducted at least once per month using any of the procedures specified in § 98.244(b)(4).
- (4) If you determine that the monthly average concentration of a specific compound in a feedstock or product is greater than 99.5 percent by volume or mass, then as an alternative to the sampling and analysis specified in paragraph (c)(3) of this section, you may determine molecular weight and carbon content in accordance with paragraphs (c)(4)(i) through (iii) of this section.
  - (i) Calculate the molecular weight and carbon content assuming 100 percent of that feedstock or product is the specific compound.
  - (ii) Maintain records of any determination made in accordance with this paragraph (c)(4) along with all supporting data, calculations, and other information.
  - (iii) Reevaluate determinations made under this paragraph (c)(4) after any process change that affects the feedstock or product composition. Keep records of the process change and the corresponding composition determinations. If the feedstock or product composition changes so that the average monthly concentration falls below 99.5 percent, you are no longer permitted to use this alternative method.
- (5) Calculate the CO<sub>2</sub> mass emissions for each petrochemical process unit using Equations X-1 through X-4 of this section.
  - (i) **Gaseous feedstocks and products.** Use Equation X-1 of this section to calculate the net annual carbon input or output from gaseous feedstocks and products. Note that the result will be a negative value if there are no gaseous feedstocks in the process but there are gaseous products.

$$C_g = \sum_{n=1}^{12} \left[ \sum_{i=1}^{jork} \left[ (F_{gf})_{i,n} * (CC_{gf})_{i,n} * \frac{(MW_f)_{i,n}}{MVC} - (P_{gp})_{i,n} * (CC_{gp})_{i,n} * \frac{(MW_p)_{i,n}}{MVC} \right] \right] \quad (\text{Eq. X-1})$$

Where:

$C_g$  = Annual net contribution to calculated emissions from carbon (C) in gaseous materials, including streams containing CO<sub>2</sub> recovered for sale or use in another process (kg/yr).

$(F_{gf})_{i,n}$  = Volume or mass of gaseous feedstock i introduced in month "n" (scf or kg). If you measure mass, the term  $(MW_f)_{i,n}/MVC$  is replaced with "1".

$(CC_{gf})_{i,n}$  = Average carbon content of the gaseous feedstock i for month "n" (kg C per kg of feedstock).

$(MW_f)_{i,n}$  = Molecular weight of gaseous feedstock i in month "n" (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf per kg-mole at 68 °F and 14.7 pounds per square inch absolute or 836.6 scf/kg-mole at 60 °F and 14.7 pounds per square inch absolute).

$(P_{gp})_{i,n}$  = Volume or mass of gaseous product i produced in month "n" (scf or kg). If you measure mass, the term  $(MW_p)_{i,n}/MVC$  is replaced with "1".

$(CC_{gp})_{i,n}$  = Average carbon content of gaseous product i, including streams containing CO<sub>2</sub> recovered for sale or use in another process, for month "n" (kg C per kg of product).

$(MW_p)_{i,n}$  = Molecular weight of gaseous product i in month "n" (kg/kg-mole).

j = Number of feedstocks.

k = Number of products.

- (ii) **Liquid feedstocks and products.** Use Equation X-2 of this section to calculate the net carbon input or output from liquid feedstocks and products. Note that the result will be a negative value if there are no liquid feedstocks in the process but there are liquid products.

$$C_l = \sum_{n=1}^{12} \left[ \sum_{i=1}^{j_{\text{feed}}} \left[ (F_{fi})_{i,n} \cdot (CC_{fi})_{i,n} - (P_{pi})_{i,n} \cdot (CC_{pi})_{i,n} \right] \right] \quad (\text{Eq. X-2})$$

Where:

$C_l$  = Annual net contribution to calculated emissions from carbon in liquid materials, including liquid organic wastes (kg/yr).

$(F_{fi})_{i,n}$  = Volume or mass of liquid feedstock i introduced in month "n" (gallons or kg).

$(CC_{fi})_{i,n}$  = Average carbon content of liquid feedstock i for month "n" (kg C per gallon or kg of feedstock).

$(P_{pi})_{i,n}$  = Volume or mass of liquid product i produced in month "n" (gallons or kg).

$(CC_{pi})_{i,n}$  = Average carbon content of liquid product i, including organic liquid wastes, for month "n" (kg C per gallon or kg of product).

j = Number of feedstocks.

k = Number of products.

- (iii) **Solid feedstocks and products.** Use Equation X-3 of this section to calculate the net annual carbon input or output from solid feedstocks and products. Note that the result will be a negative value if there are no solid feedstocks in the process but there are solid products.

$$C_s = \sum_{n=1}^{12} \left\{ \sum_{i=1}^j \left[ (F_{sf})_{i,n} \cdot (CC_{sf})_{i,n} - (P_{sp})_{i,n} \cdot (CC_{sp})_{i,n} \right] \right\} \quad (\text{Eq. X-3})$$

Where:

$C_s$  = Annual net contribution to calculated emissions from carbon in solid materials (kg/yr).

$(F_{sf})_{i,n}$  = Mass of solid feedstock i introduced in month "n" (kg).

$(CC_{sf})_{i,n}$  = Average carbon content of solid feedstock i for month "n" (kg C per kg of feedstock).

$(P_{sp})_{i,n}$  = Mass of solid product i produced in month "n" (kg).

$(CC_{sp})_{i,n}$  = Average carbon content of solid product i in month "n" (kg C per kg of product).

j = Number of feedstocks.

k = Number of products.

- (iv) **Annual emissions.** Use the results from Equations X-1 through X-3 of this section, as applicable, in Equation X-4 of this section to calculate annual CO<sub>2</sub> emissions.

$$CO_2 = 0.001 \cdot \frac{44}{12} \cdot (C_g + C_i + C_s) \quad (\text{Eq. X-4})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions from process operations and process off-gas combustion (metric tons/year).

0.001 = Conversion factor from kg to metric tons.

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

12 = Atomic weight of carbon (C) (kg/kg-mole).



- (d) **Optional combustion methodology for ethylene production processes.** For each ethylene production process, calculate GHG emissions from combustion units that burn fuel that contains any off-gas from the ethylene process as specified in paragraphs (d)(1) through (d)(5) of this section.
- (1) Except as specified in paragraphs (d)(2) and (d)(5) of this section, calculate CO<sub>2</sub> emissions using the Tier 3 or Tier 4 methodology in subpart C of this part.
  - (2) You may use either Equation C-1 or Equation C-2a in subpart C of this part to calculate CO<sub>2</sub> emissions from combustion of any ethylene process off-gas streams that meet either of the conditions in paragraphs (d)(2)(i) or (d)(2)(ii) of this section (for any default values in the calculation, use the defaults for fuel gas in Table C-1 of subpart C of this part). Follow the otherwise applicable procedures in subpart C to calculate emissions from combustion of all other fuels in the combustion unit.
    - (i) The annual average flow rate of fuel gas (that contains ethylene process off-gas) in the fuel gas line to the combustion unit, prior to any split to individual burners or ports, does not exceed 345 standard cubic feet per minute at 60 °F and 14.7 pounds per square inch absolute, and a flow meter is not installed at any point in the line supplying fuel gas or an upstream common pipe. Calculate the annual average flow rate using company records assuming total flow is evenly distributed over 525,600 minutes per year.
    - (ii) The combustion unit has a maximum rated heat input capacity of less than 30 mmBtu/hr, and a flow meter is not installed at any point in the line supplying fuel gas (that contains ethylene process off-gas) or an upstream common pipe.
  - (3) Except as specified in paragraph (d)(5) of this section, calculate CH<sub>4</sub> and N<sub>2</sub>O emissions using the applicable procedures in § 98.33(c) for the same tier methodology that you used for calculating CO<sub>2</sub> emissions.
    - (i) For all gaseous fuels that contain ethylene process off-gas, use the emission factors for “Fuel Gas” in Table C-2 of subpart C of this part (General Stationary Fuel Combustion Sources).
    - (ii) For Tier 3, use either the default high heat value for fuel gas in Table C-1 of subpart C of this part or a calculated HHV, as allowed in Equation C-8 of subpart C of this part.
  - (4) You are not required to use the same Tier for each stationary combustion unit that burns ethylene process off-gas.
  - (5) For each flare, calculate CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions using the methodology specified in § 98.253(b).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79157, Dec. 17, 2010; 78 FR 71961, Nov. 29, 2013; 81 FR 89260, Dec. 9, 2016; 89 FR 31929, Apr. 25, 2024]

#### § 98.244 Monitoring and QA/QC requirements.

- (a) If you use CEMS to determine emissions from process vents, you must comply with the procedures specified in § 98.34(c).
- (b) If you use the mass balance methodology in § 98.243(c), use the procedures specified in paragraphs (b)(1) through (b)(4) of this section to determine feedstock and product flows and carbon contents.

- (1) Operate, maintain, and calibrate belt scales or other weighing devices as described in Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices NIST Handbook 44 (2009) (incorporated by reference, see § 98.7), or follow procedures specified by the measurement device manufacturer. You must recalibrate each weighing device according to one of the following frequencies. You may recalibrate either at the minimum frequency specified by the manufacturer or biennially (*i.e.*, once every two years).
- (2) Operate and maintain all flow meters used for gas and liquid feedstocks and products according to the manufacturer's recommended procedures. You must calibrate each of these flow meters as specified in paragraphs (b)(2)(i) and (b)(2)(ii) of this section:
  - (i) You may use either the calibration methods specified by the flow meter manufacturer or an industry consensus standard method. Each flow meter must meet the applicable accuracy specification in § 98.3(i), except as otherwise specified in §§ 98.3(i)(4) through (i)(6).
  - (ii) You must recalibrate each flow meter according to one of the following frequencies. You may recalibrate at the minimum frequency specified by the manufacturer, biennially (every two years), or at the interval specified by the industry consensus standard practice used.
- (3) You must perform tank level measurements (if used to determine feedstock or product flows) according to one of the following methods. You may use any standard method published by a consensus-based standards organization or you may use an industry standard practice. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th Floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>).
- (4) Beginning January 1, 2010, use any applicable methods specified in paragraphs (b)(4)(i) through (xv) of this section to determine the carbon content or composition of feedstocks and products and the average molecular weight of gaseous feedstocks and products. Calibrate instruments in accordance with paragraphs (b)(4)(i) through (xv) of this section, as applicable. For coal used as a feedstock, the samples for carbon content determinations shall be taken at a location that is representative of the coal feedstock used during the corresponding monthly period. For carbon black products, samples shall be taken of each grade or type of product produced during the monthly period. Samples of coal feedstock or carbon black product for carbon content determinations may be either grab samples collected and analyzed monthly or a composite of samples collected more frequently and analyzed monthly. Analyses conducted in accordance with methods specified in paragraphs (b)(4)(i) through (xv) of this section may be performed by the owner or operator, by an independent laboratory, by the supplier of a feedstock, or by a product customer.
  - (i) ASTM D1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (ii) ASTM D6060-96 (Reapproved 2001) Standard Practice for Sampling of Process Vents With a Portable Gas Chromatograph (incorporated by reference, see § 98.7).

- (iii) ASTM D2505-88 (Reapproved 2004)e1 (incorporated by reference, see § 98.7).
- (iv) ASTM UOP539-97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).
- (v) ASTM D3176-89 (Reapproved 2002) Standard Practice Method for Ultimate Analysis of Coal and Coke (incorporated by reference, see § 98.7).
- (vi) ASTM D5291-02 (Reapproved 2007) Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants (incorporated by reference, see § 98.7).
- (vii) ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7).
- (viii) Method 8015C, Method 8021B, Method 8031, or Method 9060A (all incorporated by reference, see § 98.7).
- (ix) Method 18 at 40 CFR part 60, appendix A-6.
- (x) Performance Specification 9 in 40 CFR part 60, appendix B for continuous online gas analyzers. The 7-day calibration error test period must be completed prior to the effective date of the rule.
- (xi) ASTM D2593-93 (Reapproved 2009) Standard Test Method for Butadiene Purity and Hydrocarbon Impurities by Gas Chromatography (incorporated by reference, see § 98.7).
- (xii) ASTM D7633-10 Standard Test Method for Carbon Black—Carbon Content (incorporated by reference, see § 98.7).
- (xiii) The results of chromatographic analysis of a feedstock or product, provided that the chromatograph is operated, maintained, and calibrated according to the manufacturer's instructions.
- (xiv) The results of mass spectrometer analysis of a feedstock or product, provided that the mass spectrometer is operated, maintained, and calibrated according to the manufacturer's instructions.
- (xv) Beginning on January 1, 2010, the methods specified in paragraphs (b)(4)(xv)(A) and (B) of this section may be used as alternatives for the methods specified in paragraphs (b)(4)(i) through (b)(4)(xiv) of this section.
  - (A) An industry standard practice or a method published by a consensus-based standards organization if such a method exists for carbon black feedstock oils and carbon black products. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street NW., Washington, DC 20005-4070, (202) 682-8000,

<http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.naesb.org>). The method(s) used shall be documented in the monitoring plan required under § 98.3(g)(5).

(B) Modifications of existing analytical methods or other methods that are applicable to your process provided that the methods listed in paragraphs (b)(4)(i) through (b)(4)(xiv) of this section are not appropriate because the relevant compounds cannot be detected, the quality control requirements are not technically feasible, or use of the method would be unsafe.

(c) If you comply with § 98.243(b) or (d), conduct monitoring and QA/QC for flares in accordance with § 98.254(b) through (e) for each flare gas flow meter, gas composition meter, and/or heating value monitor that you use to comply with § 98.253(b)(1) through (b)(3). You must implement all applicable QA/QC requirements specified in this paragraph (c) beginning no later than January 1, 2015.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79158, Dec. 17, 2010; 78 FR 71961, Nov. 29, 2013; 89 FR 31929, Apr. 25, 2024]

### § 98.245 Procedures for estimating missing data.

For missing feedstock and product flow rates, use the same procedures as for missing fuel usage as specified in § 98.35(b)(2). For missing feedstock and product carbon contents and missing molecular weights for gaseous feedstocks and products, use the same procedures as for missing carbon contents and missing molecular weights for fuels as specified in § 98.35(b)(1).

For missing flare data, follow the procedures in § 98.255(b) and (c).

[78 FR 71962, Nov. 29, 2013]

### § 98.246 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a), (b), or (c) of this section, as appropriate for each process unit.

- (a) If you use the mass balance methodology in § 98.243(c), you must report the information specified in paragraphs (a)(1) through (15) of this section for each type of petrochemical produced, reported by process unit.
- (1) The petrochemical process unit ID number or other appropriate descriptor.
  - (2) The type of petrochemical produced.
  - (3) Annual CO<sub>2</sub> emissions calculated using Equation X-4 of this subpart.
  - (4) The temperature (in °F) at which the gaseous feedstock and product volumes used in Equation X-1 of § 98.243 were determined.
  - (5) Annual quantity of each type of petrochemical produced from each process unit (metric tons). If you are electing to consider the petrochemical process unit to be the entire integrated ethylene dichloride/vinyl chloride monomer process, the portion of the total amount of ethylene dichloride (EDC) produced that is used in vinyl chloride monomer (VCM) production may be a measured quantity or an estimate that is based on process knowledge and best available data. The portion of the total amount of EDC produced that is not utilized in VCM production must be measured in

accordance with § 98.244(b)(2) or (3). Sum the amount of EDC used in the production of VCM plus the amount of separate EDC product to report as the total quantity of EDC petrochemical from an integrated EDC/VCM petrochemical process unit.

- (6) For each feedstock and product, provide the information specified in paragraphs (a)(6)(i) through (a)(6)(iii) of this section.
  - (i) Name of each method used to determine carbon content or molecular weight in accordance with § 98.244(b)(4);
  - (ii) Description of each type of measurement device (e.g., flow meter, weighing device) used to determine volume or mass in accordance with § 98.244(b)(1) through (3).
  - (iii) Identification of each method (i.e., method number, title, or other description) used to determine volume or mass in accordance with § 98.244(b)(1) through (3).
- (7) [Reserved]
- (8) Identification of each combustion unit that burned both process off-gas and supplemental fuel, including combustion units that are not part of the petrochemical process unit.
- (9) The number of days during which off-specification product was produced if the alternative to sampling and analysis specified in § 98.243(c)(4) is used for a product, and, if applicable, the date of any process change that reduced the monthly average composition to less than 99.5 percent for each product or feedstock for which you comply with the alternative to sampling and analysis specified in § 98.243(c)(4).
- (10) You may elect to report the flow and carbon content of wastewater, and you may elect to report the annual mass of carbon released in fugitive emissions and in process vents that are not controlled with a combustion device. These values may be estimated based on engineering analyses. These values are not to be used in the mass balance calculation.
- (11) If you determine carbon content or composition of a feedstock or product using a method under § 98.244(b)(4)(xv)(B), report the information listed in paragraphs (a)(11)(i) through (a)(11)(iii) of this section. Include the information in paragraph (a)(11)(i) of this section in each annual report. Include the information in paragraphs (a)(11)(ii) and (a)(11)(iii) of this section only in the first applicable annual report, and provide any changes to this information in subsequent annual reports.
  - (i) Name or title of the analytical method.
  - (ii) A copy of the method. If the method is a modification of a method listed in §§ 98.244(b)(4)(i) through (xiv), you may provide a copy of only the sections that differ from the listed method.
  - (iii) An explanation of why an alternative to the methods listed in §§ 98.244(b)(4)(i) through (xiv) is needed.
- (12) Name and annual quantity (in metric tons) of each carbon-containing feedstock included in Equations X-1, X-2, and X-3 of § 98.243.
- (13) Name and annual quantity (in metric tons) of each product included in equations X-1, X-2, and X-3 to § 98.243. If you are electing to consider the petrochemical process unit to be the entire integrated ethylene dichloride/vinyl chloride monomer process, the reported quantity of EDC product should include only that which was not used in the VCM process.

- (14) Annual average of the measurements or determinations of the carbon content of each feedstock and product, conducted according to § 98.243(c)(3) or (4).
    - (i) For feedstocks and products that are gaseous or solid, report this quantity in kg C per kg of feedstock or product.
    - (ii) For liquid feedstocks and products, report this quantity either in units of kg C per kg of feedstock or product, or kg C per gallon of feedstock or product.
  - (15) For each gaseous feedstock or product for which the volume was used in equation X-1 to § 98.243, report the annual average molecular weight of the measurements or determinations, conducted according to § 98.243(c)(3) or (4). Report the annual average molecular weight in units of kg per kg mole.
- (b) If you measure emissions in accordance with § 98.243(b), then you must report the information listed in paragraphs (b)(1) through (10) of this section.
- (1) The petrochemical process unit ID or other appropriate descriptor, and the type of petrochemical produced.
  - (2) For CEMS used on stacks that include emissions from stationary combustion units that burn any amount of off-gas from the petrochemical process, report the relevant information required under § 98.36(c)(2) and (e)(2)(vi) for the Tier 4 calculation methodology. Section 98.36(c)(2)(ii), (ix) and (x) do not apply for the purposes of this subpart.
  - (3) For CEMS used on stacks that do not include emissions from stationary combustion units, report the information required under § 98.36(b)(6) and (7), (b)(9)(i) and (ii) and (e)(2)(vi).
  - (4) For each CEMS monitoring location that meets the conditions in paragraph (b)(2) or (3) of this section, provide an estimate based on engineering judgment of the fraction of the total CO<sub>2</sub> emissions that results from CO<sub>2</sub> directly emitted by the petrochemical process unit plus CO<sub>2</sub> generated by the combustion of off-gas from the petrochemical process unit.
  - (5) For each CEMS monitoring location that meets the conditions in paragraph (b)(2) of this section, report the CH<sub>4</sub> and N<sub>2</sub>O emissions expressed in metric tons of each gas. For each CEMS monitoring location, provide an estimate based on engineering judgment of the fraction of the total CH<sub>4</sub> and N<sub>2</sub>O emissions that is attributable to combustion of off-gas from the petrochemical process unit.
  - (6) [Reserved]
  - (7) Information listed in § 98.256(e) for each flare that burns process off-gas. Additionally, provide estimates based on engineering judgment of the fractions of the total CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions that are attributable to combustion of off-gas from the petrochemical process unit(s) served by the flare.
  - (8) Annual quantity of each type of petrochemical produced from each process unit (metric tons).
  - (9) Name and annual quantity (in metric tons) of each carbon-containing feedstock.
  - (10) Name and annual quantity (in metric tons) of each product.
- (c) If you comply with the combustion methodology specified in § 98.243(d), you must report under this subpart the information listed in paragraphs (c)(1) through (6) of this section.
- (1) The ethylene process unit ID or other appropriate descriptor.

- (2) For each stationary combustion unit that burns ethylene process off-gas (or group of stationary sources with a common pipe), except flares, the relevant information listed in § 98.36 for the applicable Tier methodology. For each stationary combustion unit or group of units (as applicable) that burns ethylene process off-gas, provide an estimate based on engineering judgment of the fraction of the total emissions that is attributable to combustion of off-gas from the ethylene process unit.
- (3) Information listed in § 98.256(e) for each flare that burns ethylene process off-gas. Additionally, provide estimates based on engineering judgment of the fractions of the total CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions that are attributable to combustion of off-gas from the ethylene process unit(s) served by the flare.
- (4) Name and annual quantity of each carbon-containing feedstock (metric tons).
- (5) Annual quantity of ethylene produced from each process unit (metric tons).
- (6) Name and annual quantity (in metric tons) of each product produced in each process unit.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79159, Dec. 17, 2010; 78 FR 71962, Nov. 29, 2013; 79 FR 63794, Oct. 24, 2014; 81 FR 89260, Dec. 9, 2016; 89 FR 31929, Apr. 25, 2024]

## § 98.247 Records that must be retained.

In addition to the recordkeeping requirements in § 98.3(g), you must retain the records specified in paragraphs (a) through (d) of this section, as applicable.

- (a) If you comply with the CEMS measurement methodology in § 98.243(b), then you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37, records of the procedures used to develop estimates of the fraction of total emissions attributable to petrochemical processing and combustion of petrochemical process off-gas as required in § 98.246(b), and records of any annual average HHV calculations.
- (b) If you comply with the mass balance methodology in § 98.243(c), then you must retain records of the information listed in paragraphs (b)(1) through (4) of this section.
  - (1) Results of feedstock or product composition determinations conducted in accordance with § 98.243(c)(4).
  - (2) Start and end times for time periods when off-specification product is produced, if you comply with the alternative methodology in § 98.243(c)(4) for determining carbon content of product.
  - (3) As part of the monitoring plan required under § 98.3(g)(5), record the estimated accuracy of measurement devices and the technical basis for these estimates.
  - (4) The dates and results (e.g., percent calibration error) of the calibrations of each measurement device.
- (c) If you comply with the combustion methodology in § 98.243(d), then you must retain under this subpart the records required for the applicable Tier Calculation Methodologies in § 98.37. If you comply with § 98.243(d)(2), you must also keep records of the annual average flow calculations.

- (d) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (30) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (30) of this section.
- (1) Indicate whether the feedstock is measured as mass or volume (Equation X-1 of § 98.243).
  - (2) Indicate whether you used the alternative to sampling and analysis specified in § 98.243(c)(4) (Equation X-1).
  - (3) Volume of gaseous feedstock introduced per month (scf) (Equation X-1).
  - (4) Mass of gaseous feedstock introduced per month (kg) (Equation X-1).
  - (5) Average carbon content of the gaseous feedstock per month (kg C per kg of feedstock) (Equation X-1).
  - (6) Molecular weight of gaseous feedstock per month (kg per kg-mole) (Equation X-1).
  - (7) Indicate whether the gaseous product is measured as mass or volume (Equation X-1).
  - (8) Volume of gaseous product produced per month (scf) (Equation X-1).
  - (9) Mass of gaseous product produced per month (kg) (Equation X-1).
  - (10) Average carbon content of gaseous product (including streams containing CO<sub>2</sub> recovered for sale or use in another process) per month (kg C per kg of product) (Equation X-1).
  - (11) Molecular weight of gaseous product per month (kg per kg-mole) (Equation X-1).
  - (12) Molar volume conversion factor of product (scf per kg-mole) (Equation X-1).
  - (13) Indicate whether feedstock is measured as mass or volume (Equation X-2 of § 98.243).
  - (14) Indicate whether you used the alternative to sampling and analysis specified in § 98.243(c)(4) (Equation X-2).
  - (15) Volume of liquid feedstock introduced per month (gallons) (Equation X-2).
  - (16) Mass of liquid feedstock introduced per month (kg) (Equation X-2).
  - (17) Average carbon content of liquid feedstock per month (kg C per gallon) (Equation X-2).
  - (18) Average carbon content of liquid feedstock per month (kg C per kg of feedstock) (Equation X-2).
  - (19) Indicate whether product is measured as mass or volume per month (Equation X-2).
  - (20) Volume of liquid product produced per month (gallons) (Equation X-2).
  - (21) Mass of liquid product produced per month (kg) (Equation X-2).
  - (22) Average carbon content of liquid product per month, including organic liquid wastes (kg C per gallon) (Equation X-2).
  - (23) Average carbon content of liquid product, including organic liquid wastes (kg C per kg of product) (Equation X-2).
  - (24) Indicate whether you used the alternative to sampling and analysis specified in § 98.243(c)(4) (Equation X-3 of § 98.243).



- (25) Mass of solid feedstock introduced per month (kg) (Equation X-3).
- (26) Average carbon content of solid feedstock per month (kg C per kg of feedstock) (Equation X-3).
- (27) Mass of solid product produced per month (kg) (Equation X-3).
- (28) Average carbon content of solid product per month (kg C per kg of product) (Equation X-3).
- (29) Records required in § 98.257(b)(1) through (8) of this section for each flare that burns ethylene process off-gas.
- (30) Records required in § 98.37 for each stationary fuel combustion unit (or group of stationary sources with a common pipe) that burns ethylene process off-gas, except flares.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79160, Dec. 17, 2010; 78 FR 71962, Nov. 29, 2013; 79 FR 63794, Oct. 24, 2014; 81 FR 89261, Dec. 9, 2016]

## § 98.248 Definitions.

Except as specified in this section, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Product** means each of the following carbon-containing outputs from a process: The petrochemical, recovered byproducts, and liquid organic wastes that are not combusted onsite. Product does not include process vent emissions, fugitive emissions, or wastewater.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71963, Nov. 29, 2013; 81 FR 89261, Dec. 9, 2016]

## Subpart Y—Petroleum Refineries

### § 98.250 Definition of source category.

- (a) A petroleum refinery is any facility engaged in producing gasoline, gasoline blending stocks, naphtha, kerosene, distillate fuel oils, residual fuel oils, lubricants, or asphalt (bitumen) through distillation of petroleum or through redistillation, cracking, or reforming of unfinished petroleum derivatives, except as provided in paragraph (b) of this section.
- (b) For the purposes of this subpart, facilities that distill only pipeline transmix (off-spec material created when different specification products mix during pipeline transportation) are not petroleum refineries, regardless of the products produced.
- (c) This source category consists of the following sources at petroleum refineries: Catalytic cracking units; fluid coking units; delayed coking units; catalytic reforming units; asphalt blowing operations; blowdown systems; storage tanks; process equipment components (compressors, pumps, valves, pressure relief devices, flanges, and connectors) in gas service; marine vessel, barge, tanker truck, and similar loading operations; flares; and sulfur recovery plants.

[74 FR 56374, Oct. 30, 2009, as amended at 89 FR 31929, Apr. 25, 2024]

## § 98.251 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a petroleum refineries process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

## § 98.252 GHGs to report.

You must report:

- (a) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions from stationary combustion units and from each flare. Calculate and report the emissions from stationary combustion units under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C, except for emissions from combustion of fuel gas. For CO<sub>2</sub> emissions from combustion of fuel gas, use either Equation C-5 in subpart C of this part or the Tier 4 methodology in subpart C of this part, unless either of the conditions in paragraphs (a)(1) or (2) of this section are met, in which case use either Equations C-1 or C-2a in subpart C of this part. For CH<sub>4</sub> and N<sub>2</sub>O emissions from combustion of fuel gas, use the applicable procedures in § 98.33(c) for the same tier methodology that was used for calculating CO<sub>2</sub> emissions. (Use the default CH<sub>4</sub> and N<sub>2</sub>O emission factors for "Fuel Gas" in Table C-2 of this part. For Tier 3, use either the default high heat value for fuel gas in Table C-1 of subpart C of this part or a calculated HHV, as allowed in Equation C-8 of subpart C of this part.) You may aggregate units, monitor common stacks, or monitor common (fuel) pipes as provided in § 98.36(c) when calculating and reporting emissions from stationary combustion units. Calculate and report the emissions from flares under this subpart.
  - (1) The annual average fuel gas flow rate in the fuel gas line to the combustion unit, prior to any split to individual burners or ports, does not exceed 345 standard cubic feet per minute at 60 °F and 14.7 pounds per square inch absolute and either of the conditions in paragraph (a)(1)(i) or (ii) of this section exist. Calculate the annual average flow rate using company records assuming total flow is evenly distributed over 525,600 minutes per year.
    - (i) A flow meter is not installed at any point in the line supplying fuel gas or an upstream common pipe.
    - (ii) The fuel gas line contains only vapors from loading or unloading, waste or wastewater handling, and remediation activities that are combusted in a thermal oxidizer or thermal incinerator.
  - (2) The combustion unit has a maximum rated heat input capacity of less than 30 mmBtu/hr and either of the following conditions exist:
    - (i) A flow meter is not installed at any point in the line supplying fuel gas or an upstream common pipe; or
    - (ii) The fuel gas line contains only vapors from loading or unloading, waste or wastewater handling, and remediation activities that are combusted in a thermal oxidizer or thermal incinerator.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O coke burn-off emissions from each catalytic cracking unit, fluid coking unit, and catalytic reforming unit under this subpart.
- (c) CO<sub>2</sub> emissions from sour gas sent off site for sulfur recovery operations under this subpart. You must follow the calculation methodologies from § 98.253(f) and the monitoring and QA/QC methods, missing data procedures, reporting requirements, and recordkeeping requirements of this subpart.
- (d) CO<sub>2</sub> process emissions from each on-site sulfur recovery plant under this subpart.

- (e) [Reserved]
- (f) CO<sub>2</sub> and CH<sub>4</sub> emissions from asphalt blowing operations under this subpart.
- (g) CH<sub>4</sub> emissions from equipment leaks, storage tanks, loading operations, delayed coking units, and uncontrolled blowdown systems under this subpart.
- (h) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each process vent not specifically included in paragraphs (a) through (g) of this section under this subpart.
- (i) [Reserved]

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79160, Dec. 17, 2010; 78 FR 71963, Nov. 29, 2013; 89 FR 31929, Apr. 25, 2024]

## § 98.253 Calculating GHG emissions.

- (a) Calculate GHG emissions required to be reported in § 98.252(b) through (i) using the applicable methods in paragraphs (b) through (n) of this section.
- (b) For flares, calculate GHG emissions according to the requirements in paragraphs (b)(1) through (3) of this section. All gas discharged through the flare stack must be included in the flare GHG emissions calculations with the exception of the following, which may be excluded as applicable: gas used for the flare pilots, and if using the calculation method in paragraph (b)(1)(iii) of this section, the gas released during start-up, shutdown, or malfunction events of 500,000 scf/day or less.
  - (1) Calculate the CO<sub>2</sub> emissions according to the applicable requirements in paragraphs (b)(1)(i) through (b)(1)(iii) of this section.
    - (i) **Flow measurement.** If you have a continuous flow monitor on the flare, you must use the measured flow rates when the monitor is operational and the flow rate is within the calibrated range of the measurement device to calculate the flare gas flow. If you do not have a continuous flow monitor on the flare and for periods when the monitor is not operational or the flow rate is outside the calibrated range of the measurement device, you must use engineering calculations, company records, or similar estimates of volumetric flare gas flow.
    - (ii) **Heat value or carbon content measurement.** If you have a continuous higher heating value monitor or gas composition monitor on the flare or if you monitor these parameters at least weekly, you must use the measured heat value or carbon content value in calculating the CO<sub>2</sub> emissions from the flare using the applicable methods in paragraphs (b)(1)(ii)(A) and (b)(1)(ii)(B).
      - (A) If you monitor gas composition, calculate the CO<sub>2</sub> emissions from the flare using either Equation Y-1a or Equation Y-1b of this section. If daily or more frequent measurement data are available, you must use daily values when using Equation Y-1a or Equation Y-1b of this section; otherwise, use weekly values.

$$CO_2 = 0.98 \times 0.001 \times \left( \sum_{p=1}^n \left[ \frac{44}{12} \times (Flare)_p \times \frac{(MW)_p}{MVC} \times (CC)_p \right] \right) \quad (\text{Eq. Y-1a})$$

where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions for a specific fuel type (metric tons/year).

0.98 = Assumed combustion efficiency of a flare.

0.001 = Unit conversion factor (metric tons per kilogram, mt/kg).

n = Number of measurement periods. The minimum value for n is 52 (for weekly measurements); the maximum value for n is 366 (for daily measurements during a leap year).

p = Measurement period index.

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

12 = Atomic weight of C (kg/kg-mole).

(Flare)<sub>p</sub> = Volume of flare gas combusted during measurement period (standard cubic feet per period, scf/period). If a mass flow meter is used, measure flare gas flow rate in kg/period and replace the term "(MW)<sub>p</sub>/MVC" with "1".

(MW)<sub>p</sub> = Average molecular weight of the flare gas combusted during measurement period (kg/kg-mole). If measurements are taken more frequently than daily, use the arithmetic average of measurement values within the day to calculate a daily average.

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 pounds per square inch absolute (psia) or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

(CC)<sub>p</sub> = Average carbon content of the flare gas combusted during measurement period (kg C per kg flare gas). If measurements are taken more frequently than daily, use the arithmetic average of measurement values within the day to calculate a daily average.

$$CO_2 = \sum_{p=1}^n \left[ (Flare)_p \times \frac{44}{MVC} \times 0.001 \times \left( \frac{(\%CO_2)_p}{100\%} + \sum_{x=1}^y \left\{ 0.98 \times \frac{(\%C_x)_p}{100\%} \times CMN_x \right\} \right) \right] \quad (Eq. Y-1b)$$

where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions for a specific fuel type (metric tons/year).

n = Number of measurement periods. The minimum value for n is 52 (for weekly measurements); the maximum value for n is 366 (for daily measurements during a leap year).

p = Measurement period index.

(Flare)<sub>p</sub> = Volume of flare gas combusted during measurement period (standard cubic feet per period, scf/period). If a mass flow meter is used, you must determine the average molecular weight of the flare gas during the measurement period and convert the mass flow to a volumetric flow.

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

0.001 = Unit conversion factor (metric tons per kilogram, mt/kg).

(%CO<sub>2</sub>)<sub>p</sub> = Mole percent CO<sub>2</sub> concentration in the flare gas stream during the measurement period (mole percent = percent by volume).

y = Number of carbon-containing compounds other than CO<sub>2</sub> in the flare gas stream.

x = Index for carbon-containing compounds other than CO<sub>2</sub>.

0.98 = Assumed combustion efficiency of a flare (mole CO<sub>2</sub> per mole carbon).

(%C<sub>x</sub>)<sub>p</sub> = Mole percent concentration of compound "x" in the flare gas stream during the measurement period (mole percent = percent by volume)

CMN<sub>x</sub> = Carbon mole number of compound "x" in the flare gas stream (mole carbon atoms per mole compound). E.g., CMN for ethane (C<sub>2</sub>H<sub>6</sub>) is 2; CMN for propane (C<sub>3</sub>H<sub>8</sub>) is 3.

- (B) If you monitor heat content but do not monitor gas composition, calculate the CO<sub>2</sub> emissions from the flare using Equation Y-2 of this section. If daily or more frequent measurement data are available, you must use daily values when using Equation Y-2 of this section; otherwise, use weekly values.

$$CO_2 = 0.98 \times 0.001 \times \sum_{p=1}^n \left[ (Flare)_p \times (HHV)_p \times Emf \right] \quad (Eq. Y-2)$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions for a specific fuel type (metric tons/year).

0.98 = Assumed combustion efficiency of a flare.

0.001 = Unit conversion factor (metric tons per kilogram, mt/kg).

n = Number of measurement periods. The minimum value for n is 52 (for weekly measurements); the maximum value for n is 366 (for daily measurements during a leap year).

p = Measurement period index.

(Flare)<sub>p</sub> = Volume of flare gas combusted during measurement period (million (MM) scf/period). If a mass flow meter is used, you must also measure molecular weight and convert the mass flow to a volumetric flow as follows: Flare[MMscf] = 0.000001 × Flare[kg] × MVC/(MW)<sub>p</sub>, where MVC is the molar volume conversion factor

[849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia depending on the standard conditions used when determining  $(HHV)_p$ ] and  $(MW)_p$  is the average molecular weight of the flare gas combusted during measurement period (kg/kg-mole).

$(HHV)_p$  = Higher heating value for the flare gas combusted during measurement period (British thermal units per scf, Btu/scf = MMBtu/MMscf). If measurements are taken more frequently than daily, use the arithmetic average of measurement values within the day to calculate a daily average.

EmF = Default CO<sub>2</sub> emission factor of 60 kilograms CO<sub>2</sub>/MMBtu (HHV basis).

(iii) **Alternative to heat value or carbon content measurements.** If you do not measure the higher heating value or carbon content of the flare gas at least weekly, determine the quantity of gas discharged to the flare separately for periods of routine flare operation and for periods of start-up, shutdown, or malfunction, and calculate the CO<sub>2</sub> emissions as specified in paragraphs (b)(1)(iii)(A) through (b)(1)(iii)(C) of this section.

- (A) For periods of start-up, shutdown, or malfunction, use engineering calculations and process knowledge to estimate the carbon content of the flared gas for each start-up, shutdown, or malfunction event exceeding 500,000 scf/day.
- (B) For periods of normal operation, use the average higher heating value measured for the fuel gas used as flare sweep or purge gas for the higher heating value of the flare gas. If higher heating value of the fuel gas is not measured, the higher heating value of the flare gas under normal operations may be estimated from historic data or engineering calculations.

(C) Calculate the CO<sub>2</sub> emissions using Equation Y-3 of this section.

$$CO_2 = 0.98 \times 0.001 \times \left( Flare_{Norm} \times HHV \times EmF + \sum_{p=1}^n \left[ \frac{44}{12} \times (Flare_{Start})_p \times \frac{(MW)_p}{MVC} \times (CC)_p \right] \right) \quad (Eq. Y-3)$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions for a specific fuel type (metric tons/year).

0.98 = Assumed combustion efficiency of a flare.

0.001 = Unit conversion factor (metric tons per kilogram, mt/kg).

Flare<sub>Norm</sub> = Annual volume of flare gas combusted during normal operations from company records, (million (MM) standard cubic feet per year, MMscf/year).

HHV = Higher heating value for fuel gas or flare gas from company records (British thermal units per scf, Btu/scf = MMBtu/MMscf).

EmF = Default CO<sub>2</sub> emission factor for flare gas of 60 kilograms CO<sub>2</sub>/MMBtu (HHV basis).

n = Number of start-up, shutdown, and malfunction events during the reporting year exceeding 500,000 scf/day.

p = Start-up, shutdown, and malfunction event index.

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

12 = Atomic weight of C (kg/kg-mole).

(Flare<sub>SSM</sub>)<sub>p</sub> = Volume of flare gas combusted during indexed start-up, shutdown, or malfunction event from engineering calculations, (scf/event).

(MW)<sub>p</sub> = Average molecular weight of the flare gas, from the analysis results or engineering calculations for the event (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

(CC)<sub>p</sub> = Average carbon content of the flare gas, from analysis results or engineering calculations for the event (kg C per kg flare gas).

(2) Calculate CH<sub>4</sub> using Equation Y-4 of this section.

$$CH_4 = \left( CO_2 \times \frac{EmF_{CH_4}}{EmF} \right) + CO_2 \times \frac{0.02}{0.98} \times \frac{16}{44} \times f_{CH_4} \quad (Eq. Y-4)$$

Where:

CH<sub>4</sub> = Annual methane emissions from flared gas (metric tons CH<sub>4</sub>/year).

CO<sub>2</sub> = Emission rate of CO<sub>2</sub> from flared gas calculated in paragraph (b)(1) of this section (metric tons/year).

EmF<sub>CH<sub>4</sub></sub> = Default CH<sub>4</sub> emission factor for "Fuel Gas" from Table C-2 of subpart C of this part (General Stationary Fuel Combustion Sources) (kg CH<sub>4</sub>/MMBtu).

EmF = Default CO<sub>2</sub> emission factor for flare gas of 60 kg CO<sub>2</sub>/MMBtu (HHV basis).

0.02/0.98 = Correction factor for flare combustion efficiency.

16/44 = Correction factor ratio of the molecular weight of CH<sub>4</sub> to CO<sub>2</sub>.

f<sub>CH<sub>4</sub></sub> = Weight fraction of carbon in the flare gas prior to combustion that is contributed by methane from measurement values or engineering calculations (kg C in methane in flare gas/kg C in flare gas); default is 0.4.

(3) Calculate N<sub>2</sub>O emissions using Equation Y-5 of this section.

$$N_2O = \left( CO_2 \times \frac{EmF_{N_2O}}{EmF} \right) \quad (Eq. Y-5)$$

Where:

$N_2O$  = Annual nitrous oxide emissions from flared gas (metric tons  $N_2O$ /year).

$CO_2$  = Emission rate of  $CO_2$  from flared gas calculated in paragraph (b)(1) of this section (metric tons/year).

$EmF_{N_2O}$  = Default  $N_2O$  emission factor for "Fuel Gas" from Table C-2 of subpart C of this part (General Stationary Fuel Combustion Sources) (kg  $N_2O$ /MMBtu).

$EmF$  = Default  $CO_2$  emission factor for flare gas of 60 kg  $CO_2$ /MMBtu (HHV basis).

(c) For catalytic cracking units and traditional fluid coking units, calculate the GHG emissions from coke burn-off using the applicable methods described in paragraphs (c)(1) through (5) of this section.

(1) If you operate and maintain a CEMS that measures  $CO_2$  emissions according to subpart C of this part (General Stationary Fuel Combustion Sources), you must calculate and report  $CO_2$  emissions as provided in paragraphs (c)(1)(i) and (c)(1)(ii) of this section. Other catalytic cracking units and traditional fluid coking units must either install a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Combustion Sources), or follow the requirements of paragraphs (c)(2) or (3) of this section.

(i) Calculate  $CO_2$  emissions by following the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).

(ii) For catalytic cracking units whose process emissions are discharged through a combined stack with other  $CO_2$  emissions (e.g., co-mingled with emissions from a CO boiler) you must also calculate the other  $CO_2$  emissions using the applicable methods for the applicable subpart (e.g., subpart C of this part in the case of a CO boiler). Calculate the process emissions from the catalytic cracking unit or fluid coking unit as the difference in the  $CO_2$  CEMS emissions and the calculated emissions associated with the additional units discharging through the combined stack.

(2) For catalytic cracking units and fluid coking units with rated capacities greater than 10,000 barrels per stream day (bbls/sd) that do not use a continuous  $CO_2$  CEMS for the final exhaust stack, you must continuously or no less frequently than hourly monitor the  $O_2$ ,  $CO_2$ , and (if necessary) CO concentrations in the exhaust stack from the catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels and calculate the  $CO_2$  emissions according to the requirements of paragraphs (c)(2)(i) through (c)(2)(iii) of this section:

(i) Calculate the  $CO_2$  emissions from each catalytic cracking unit and fluid coking unit using Equation Y-6 of this section.

$$CO_2 = \sum_{j=1}^n \left[ (Q_r)_j \times \frac{(\%CO_2 + \%CO)_j}{100\%} \times \frac{44}{MVC} \times 0.001 \right] \quad (\text{Eq. Y-6})$$

Where:

$CO_2$  = Annual  $CO_2$  mass emissions (metric tons/year).



$Q_r$  = Volumetric flow rate of exhaust gas from the fluid catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels (dry standard cubic feet per hour, dscfh).

%CO<sub>2</sub> = Hourly average percent CO<sub>2</sub> concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (percent by volume—dry basis).

%CO = Hourly average percent CO concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (percent by volume—dry basis). When there is no post-combustion device, assume %CO to be zero.

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

0.001 = Conversion factor (metric ton/kg).

n = Number of hours in calendar year.

- (ii) Either continuously monitor the volumetric flow rate of exhaust gas from the fluid catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels or calculate the volumetric flow rate of this exhaust gas stream using either Equation Y-7a or Equation Y-7b of this section.

$$Q_r = \frac{(79 * Q_a + (100 - \%O_{oxy}) * Q_{oxy})}{100 - \%CO_2 - \%CO - \%O_2} \quad (\text{Eq. Y-7a})$$

where:

$Q_r$  = Volumetric flow rate of exhaust gas from the fluid catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels (dscfh).

$Q_a$  = Volumetric flow rate of air to the fluid catalytic cracking unit regenerator or fluid coking unit burner, as determined from control room instrumentation (dscfh).

$Q_{oxy}$  = Volumetric flow rate of oxygen enriched air to the fluid catalytic cracking unit regenerator or fluid coking unit burner as determined from control room instrumentation (dscfh).

%O<sub>2</sub> = Hourly average percent oxygen concentration in exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (percent by volume—dry basis).

%O<sub>oxy</sub> = O<sub>2</sub> concentration in oxygen enriched gas stream inlet to the fluid catalytic cracking unit regenerator or fluid coking unit burner based on oxygen purity specifications of the oxygen supply used for enrichment (percent by volume—dry basis).

%CO<sub>2</sub> = Hourly average percent CO<sub>2</sub> concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (percent by volume—dry basis).

%CO = Hourly average percent CO concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (percent by volume—dry basis). When no auxiliary fuel is burned and a continuous CO monitor is not required under 40 CFR part 63 subpart UUU, assume %CO to be zero.

$$Q_r = \frac{(78.1 * Q_a + (\%N_{2,oxy}) * Q_{oxy})}{\%N_{2,exhaust}} \quad (\text{Eq. Y-7b})$$

where:

Q<sub>r</sub> = Volumetric flow rate of exhaust gas from the fluid catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels (dscfh).

Q<sub>a</sub> = Volumetric flow rate of air to the fluid catalytic cracking unit regenerator or fluid coking unit burner, as determined from control room instrumentation (dscfh).

Q<sub>oxy</sub> = Volumetric flow rate of oxygen enriched air to the fluid catalytic cracking unit regenerator or fluid coking unit burner as determined from control room instrumentation (dscfh).

%N<sub>2,oxy</sub> = N<sub>2</sub> concentration in oxygen enriched gas stream inlet to the fluid catalytic cracking unit regenerator or fluid coking unit burner based on measured value or maximum N<sub>2</sub> impurity specifications of the oxygen supply used for enrichment (percent by volume—dry basis).

%N<sub>2,exhaust</sub> = Hourly average percent N<sub>2</sub> concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (percent by volume—dry basis).

- (iii) If you have a CO boiler that uses auxiliary fuels or combusts materials other than catalytic cracking unit or fluid coking unit exhaust gas, you must determine the CO<sub>2</sub> emissions resulting from the combustion of these fuels or other materials following the requirements in subpart C and report those emissions by following the requirements of subpart C of this part.
- (3) For catalytic cracking units and fluid coking units with rated capacities of 10,000 barrels per stream day (bbls/sd) or less that do not use a continuous CO<sub>2</sub> CEMS for the final exhaust stack, comply with the requirements in paragraph (c)(3)(i) of this section or paragraphs (c)(3)(ii) and (c)(3)(iii) of this section, as applicable.
  - (i) If you continuously or no less frequently than daily monitor the O<sub>2</sub>, CO<sub>2</sub>, and (if necessary) CO concentrations in the exhaust stack from the catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels, you must calculate the CO<sub>2</sub> emissions according to the requirements of paragraphs (c)(2)(i) through (c)(2)(iii) of this section, except that daily averages are allowed and the summation can be performed on a daily basis.

- (ii) If you do not monitor at least daily the O<sub>2</sub>, CO<sub>2</sub>, and (if necessary) CO concentrations in the exhaust stack from the catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels, calculate the CO<sub>2</sub> emissions from each catalytic cracking unit and fluid coking unit using Equation Y-8 of this section.

$$CO_2 = Q_{unit} \times (CBF \times 0.001) \times CC \times \frac{44}{12} \quad (\text{Eq. Y-8})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions (metric tons/year).

Q<sub>unit</sub> = Annual throughput of unit from company records (barrels (bbls) per year, bbl/yr).

CBF = Coke burn-off factor from engineering calculations (kg coke per barrel of feed); default for catalytic cracking units = 7.3; default for fluid coking units = 11.

0.001 = Conversion factor (metric ton/kg).

CC = Carbon content of coke based on measurement or engineering estimate (kg C per kg coke); default = 0.94.

44/12 = Ratio of molecular weight of CO<sub>2</sub> to C (kg CO<sub>2</sub> per kg C).

- (iii) If you have a CO boiler that uses auxiliary fuels or combusts materials other than catalytic cracking unit or fluid coking unit exhaust gas, you must determine the CO<sub>2</sub> emissions resulting from the combustion of these fuels or other materials following the requirements in subpart C of this part (General Stationary Fuel Combustion Sources) and report those emissions by following the requirements of subpart C of this part.

- (4) Calculate CH<sub>4</sub> emissions using either unit specific measurement data, a unit-specific emission factor based on a source test of the unit, or equation Y-9 to this section.

$$CH_4 = \left( CO_2 * \frac{EmF_2}{EmF_1} \right) \quad (\text{Eq. Y-9})$$

Where:

CH<sub>4</sub> = Annual methane emissions from coke burn-off (metric tons CH<sub>4</sub>/year).

CO<sub>2</sub> = Emission rate of CO<sub>2</sub> from coke burn-off calculated in paragraphs (c)(1), (c)(2), (e)(1), or (e)(2) of this section, as applicable (metric tons/year).

EmF<sub>1</sub> = Default CO<sub>2</sub> emission factor for petroleum coke from table C-1 to subpart C of this part (kg CO<sub>2</sub>/MMBtu).

EmF<sub>2</sub> = Default CH<sub>4</sub> emission factor for "Petroleum Products" from table C-2 to subpart C of this part (kg CH<sub>4</sub>/MMBtu).

- (5) Calculate N<sub>2</sub>O emissions using either unit specific measurement data, a unit-specific emission factor based on a source test of the unit, or equation Y-10 to this section.

$$N_2O = \left( CO_2 * \frac{EmF_3}{EmF_1} \right) \quad (Eq. Y-10)$$

Where:

N<sub>2</sub>O = Annual nitrous oxide emissions from coke burn-off (mt N<sub>2</sub>O/year).

CO<sub>2</sub> = Emission rate of CO<sub>2</sub> from coke burn-off calculated in paragraphs (c)(1), (c)(2), (e)(1), or (e)(2) of this section, as applicable (metric tons/year).

EmF<sub>1</sub> = Default CO<sub>2</sub> emission factor for petroleum coke from table C-1 to subpart C of this part (kg CO<sub>2</sub>/MMBtu).

EmF<sub>3</sub> = Default N<sub>2</sub>O emission factor for "PetroleumProducts" from table C-2 to subpart C of this part (kg N<sub>2</sub>O/MMBtu).

- (d) For fluid coking units that use the flexicoking design, the GHG emissions from the resulting use of the low value fuel gas must be accounted for only once. Typically, these emissions will be accounted for using the methods described in subpart C of this part (General Stationary Fuel Combustion Sources). Alternatively, you may use the methods in paragraph (c) of this section provided that you do not otherwise account for the subsequent combustion of this low value fuel gas.
- (e) For catalytic reforming units, calculate the CO<sub>2</sub> emissions from coke burn-off using the applicable methods described in paragraphs (e)(1) through (3) of this section and calculate the CH<sub>4</sub> and N<sub>2</sub>O emissions using the methods described in paragraphs (c)(4) and (5) of this section, respectively.
- (1) If you operate and maintain a CEMS that measures CO<sub>2</sub> emissions according to subpart C of this part (General Stationary Fuel Combustion Sources), you must calculate CO<sub>2</sub> emissions as provided in paragraphs (c)(1)(i) and (c)(1)(ii) of this section. Other catalytic reforming units must either install a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part, or follow the requirements of paragraph (e)(2) or (e)(3) of this section.
- (2) If you continuously or no less frequently than daily monitor the O<sub>2</sub>, CO<sub>2</sub>, and (if necessary) CO concentrations in the exhaust stack from the catalytic reforming unit catalyst regenerator prior to the combustion of other fossil fuels, you must calculate the CO<sub>2</sub> emissions according to the requirements of paragraphs (c)(2)(i) through (c)(2)(iii) of this section.
- (3) Calculate CO<sub>2</sub> emissions from the catalytic reforming unit catalyst regenerator using Equation Y-11 of this section.

$$CO_2 = \sum_i^n \left[ (CBG_i)_n \times CC \times \frac{44}{12} \times 0.001 \right] \quad (Eq. Y-11)$$

Where:

$\text{CO}_2$  = Annual  $\text{CO}_2$  emissions (metric tons/year).

$\text{CB}_Q$  = Coke burn-off quantity per regeneration cycle or measurement period from engineering estimates (kg coke/cycle or kg coke/measurement period).

$n$  = Number of regeneration cycles or measurement periods in the calendar year.

$\text{CC}$  = Carbon content of coke based on measurement or engineering estimate (kg C per kg coke); default = 0.94.

$44/12$  = Ratio of molecular weight of  $\text{CO}_2$  to C (kg  $\text{CO}_2$  per kg C).

0.001 = Conversion factor (metric ton/kg).

- (f) For on-site sulfur recovery plants and for sour gas sent off site for sulfur recovery, calculate and report  $\text{CO}_2$  process emissions from sulfur recovery plants according to the requirements in paragraphs (f)(1) through (f)(5) of this section, or, for non-Claus sulfur recovery plants, according to the requirements in paragraph (j) of this section regardless of the concentration of  $\text{CO}_2$  in the vented gas stream. Combustion emissions from the sulfur recovery plant (e.g., from fuel combustion in the Claus burner or the tail gas treatment incinerator) must be reported under subpart C of this part (General Stationary Fuel Combustion Sources). For the purposes of this subpart, the sour gas stream for which monitoring is required according to paragraphs (f)(2) through (f)(5) of this section is not considered a fuel.
- (1) If you operate and maintain a CEMS that measures  $\text{CO}_2$  emissions according to subpart C of this part, you must calculate  $\text{CO}_2$  emissions under this subpart by following the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources). You must monitor fuel use in the Claus burner, tail gas incinerator, or other combustion sources that discharge via the final exhaust stack from the sulfur recovery plant and calculate the combustion emissions from the fuel use according to subpart C of this part. Calculate the process emissions from the sulfur recovery plant as the difference in the  $\text{CO}_2$  CEMS emissions and the calculated combustion emissions associated with the sulfur recovery plant final exhaust stack. Other sulfur recovery plants must either install a CEMS that complies with the Tier 4 Calculation Methodology in subpart C, or follow the requirements of paragraphs (f)(2) through (f)(5) of this section, or (for non-Claus sulfur recovery plants only) follow the requirements in paragraph (j) of this section to determine  $\text{CO}_2$  emissions for the sulfur recovery plant.
- (2) Flow measurement. If you have a continuous flow monitor on the sour gas feed to the sulfur recovery plant or the sour gas feed sent for off-site sulfur recovery, you must use the measured flow rates when the monitor is operational to calculate the sour gas flow rate. If you do not have a continuous flow monitor on the sour gas feed to the sulfur recovery plant or the sour gas feed sent for off-site sulfur recovery, you must use engineering calculations, company records, or similar estimates of volumetric sour gas flow.

- (3) Carbon content. If you have a continuous gas composition monitor capable of measuring carbon content on the sour gas feed to the sulfur recovery plant or the sour gas feed sent for off-site for sulfur recovery, or if you monitor gas composition for carbon content on a routine basis, you must use the measured carbon content value. Alternatively, you may develop a site-specific carbon content factor using limited measurement data or engineering estimates or use the default factor of 0.20.
- (4) Calculate the CO<sub>2</sub> emissions from each on-site sulfur recovery plant and for sour gas sent off-site for sulfur recovery using Equation Y-12 of this section.

$$CO_2 = F_{SG} \cdot \frac{44}{MVC} \cdot MF_C \cdot 0.001 \quad (\text{Eq. Y-12})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions (metric tons/year).

F<sub>SG</sub> = Volumetric flow rate of sour gas (including sour water stripper gas) fed to the sulfur recovery plant or the sour gas feed sent off-site for sulfur recovery (scf/year).

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

MF<sub>C</sub> = Mole fraction of carbon in the sour gas fed to the sulfur recovery plant or the sour gas feed sent off-site for sulfur recovery (kg-mole C/kg-mole gas); default = 0.20.

0.001 = Conversion factor, kg to metric tons.

- (5) If tail gas is recycled to the front of the sulfur recovery plant and the recycled flow rate and carbon content is included in the measured data under paragraphs (f)(2) and (f)(3) of this section, respectively, then the annual CO<sub>2</sub> emissions calculated in paragraph (f)(4) of this section must be corrected to avoid double counting these emissions. You may use engineering estimates to perform this correction or assume that the corrected CO<sub>2</sub> emissions are 95 percent of the uncorrected value calculated using Equation Y-12 of this section.

(g) [Reserved]

(h) For asphalt blowing operations, calculate CO<sub>2</sub> and CH<sub>4</sub> emissions according to the requirements in paragraph (j) of this section regardless of the CO<sub>2</sub> and CH<sub>4</sub> concentrations or according to the applicable provisions in paragraphs (h)(1) and (h)(2) of this section.

- (1) For uncontrolled asphalt blowing operations or asphalt blowing operations controlled either by vapor scrubbing or by another non-combustion control device, calculate CO<sub>2</sub> and CH<sub>4</sub> emissions using Equations Y-14 and Y-15 of this section, respectively.

$$CO_2 = (Q_{AB} \times EF_{ABCO_2}) \quad (\text{Eq. Y-14})$$

Where:

$CO_2$  = Annual  $CO_2$  emissions from uncontrolled asphalt blowing (metric tons  $CO_2$ /year).

$Q_{AB}$  = Quantity of asphalt blown (million barrels per year, MMbbl/year).

$EF_{AB,CO_2}$  = Emission factor for  $CO_2$  from uncontrolled asphalt blowing from facility-specific test data (metric tons  $CO_2$ /MMbbl asphalt blown); default = 1,100.

$$CH_4 = (Q_{AB} \times EF_{AB,CH_4}) \quad (\text{Eq. Y-15})$$

Where:

$CH_4$  = Annual methane emissions from uncontrolled asphalt blowing (metric tons  $CH_4$ /year).

$Q_{AB}$  = Quantity of asphalt blown (million barrels per year, MMbbl/year).

$EF_{AB,CH_4}$  = Emission factor for  $CH_4$  from uncontrolled asphalt blowing from facility-specific test data (metric tons  $CH_4$ /MMbbl asphalt blown); default = 580.

- (2) For asphalt blowing operations controlled by either a thermal oxidizer, a flare, or other vapor combustion control device, calculate  $CO_2$  using either Equation Y-16a or Y-16b of this section and calculate  $CH_4$  emissions using Equation Y-17 of this section, provided these emissions are not already included in the flare emissions calculated in paragraph (b) of this section or in the stationary combustion unit emissions required under subpart C of this part (General Stationary Fuel Combustion Sources).

$$CO_2 = 0.98 \times \left( Q_{AB} \times CEF_{AB} \times \frac{44}{12} \right) \quad (\text{Eq. Y-16a})$$

where:

$CO_2$  = Annual  $CO_2$  emissions from controlled asphalt blowing (metric tons  $CO_2$ /year).

0.98 = Assumed combustion efficiency of the control device.

$Q_{AB}$  = Quantity of asphalt blown (MMbbl/year).

$CEF_{AB}$  = Carbon emission factor from asphalt blowing from facility-specific test data (metric tons C/MMbbl asphalt blown); default = 2,750.

44 = Molecular weight of  $CO_2$  (kg/kg-mole).

12 = Atomic weight of C (kg/kg-mole).

$$CO_2 = Q_{AB} \times \left( EF_{AB,CO_2} + 0.98 \times \left[ \left( CEF_{AB} \times \frac{44}{12} \right) - EF_{AB,CO_2} \right] \right) \quad (\text{Eq. Y-16b})$$



where:

$CO_2$  = Annual  $CO_2$  emissions from controlled asphalt blowing (metric tons  $CO_2$ /year).

$Q_{AB}$  = Quantity of asphalt blown (MMbbl/year).

0.98 = Assumed combustion efficiency of the control device.

$EF_{AB,CO_2}$  = Emission factor for  $CO_2$  from uncontrolled asphalt blowing from facility-specific test data (metric tons  $CO_2$ /MMbbl asphalt blown); default = 1,100.

$CEF_{AB}$  = Carbon emission factor from asphalt blowing from facility-specific test data (metric tons C/MMbbl asphalt blown); default = 2,750.

44 = Molecular weight of  $CO_2$  (kg/kg-mole).

12 = Atomic weight of C (kg/kg-mole).

$$CH_4 = 0.02 \times (Q_{AB} \times EF_{AB,CH_4}) \quad (\text{Eq. Y-17})$$

where:

$CH_4$  = Annual methane emissions from controlled asphalt blowing (metric tons  $CH_4$ /year).

0.02 = Fraction of methane uncombusted in the controlled stream based on assumed 98% combustion efficiency.

$Q_{AB}$  = Quantity of asphalt blown (million barrels per year, MMbbl/year).

$EF_{AB,CH_4}$  = Emission factor for  $CH_4$  from uncontrolled asphalt blowing from facility-specific test data (metric tons  $CH_4$ /MMbbl asphalt blown); default = 580.

- (i) For each delayed coking unit, calculate the  $CH_4$  emissions from delayed decoking operations (venting, draining, deheading, and coke-cutting) according to the requirements in paragraphs (i)(1) through (5) of this section.
  - (1) Determine the typical dry mass of coke produced per cycle from company records of the mass of coke produced by the delayed coking unit. Alternatively, you may estimate the typical dry mass of coke produced per cycle based on the delayed coking unit vessel (coke drum) dimensions and typical coke drum outage at the end of the coking cycle using Equation Y-18a of this section.

$$M_{\text{coke}} = \rho_{\text{bulk}} \times \left( (H_{\text{drum}} - H_{\text{outage}}) \times \frac{\pi \times D^2}{4} \right) \quad (\text{Eq. Y-18a})$$

Where:



$M_{\text{coke}}$  = Typical dry mass of coke in the delayed coking unit vessel at the end of the coking cycle (metric tons/cycle).

$\rho_{\text{bulk}}$  = Bulk coke bed density (metric tons per cubic feet; mt/ft<sup>3</sup>). Use the default value of 0.0191 mt/ft<sup>3</sup>.

$H_{\text{drum}}$  = Internal height of delayed coking unit vessel (feet).

$H_{\text{outage}}$  = Typical distance from the top of the delayed coking unit vessel to the top of the coke bed (i.e., coke drum outage) at the end of the coking cycle (feet) from company records or engineering estimates.

$D$  = Diameter of delayed coking unit vessel (feet).

- (2) Determine the typical mass of water in the delayed coking unit vessel at the end of the cooling cycle prior to venting to the atmosphere using equation Y-18b to this section.

$$M_{\text{water}} = \rho_{\text{water}} \times \left( (H_{\text{water}}) \times \frac{\pi \times D^2}{4} - \frac{f_{\text{coke}} \times M_{\text{coke}}}{\rho_{\text{particle}}} \right) \quad (\text{Eq. Y-18b})$$

Where:

$M_{\text{water}}$  = Mass of water in the delayed coking unit vessel at the end of the cooling cycle just prior to atmospheric venting or draining (metric tons/cycle).

$\rho_{\text{water}}$  = Density of water at average temperature of the delayed coking unit vessel at the end of the cooling cycle just prior to atmospheric venting (metric tons per cubic feet; mt/ft<sup>3</sup>). Use the default value of 0.0270 mt/ft<sup>3</sup>.

$H_{\text{water}}$  = Typical distance from the bottom of the coking unit vessel to the top of the water level at the end of the cooling cycle just prior to atmospheric venting or draining (feet) from company records or engineering estimates.

$f_{\text{coke}}$  = Fraction of the coke-filled bed that is covered by water at the end of the cooling cycle just prior to atmospheric venting or draining. Use 1 if the water fully covers coke-filled portion of the coke drum.

$M_{\text{coke}}$  = Typical dry mass of coke in the delayed coking unit vessel at the end of the coking cycle (metric tons/cycle) as determined in paragraph (i)(1) of this section.

$\rho_{\text{particle}}$  = Particle density of coke (metric tons per cubic feet; mt/ft<sup>3</sup>). Use the default value of 0.0382 mt/ft<sup>3</sup>.

$D$  = Diameter of delayed coking unit vessel (feet).

- (3) Determine the average temperature of the delayed coking unit vessel when the drum is first vented to the atmosphere using either Equation Y-18c or Y-18d of this section, as appropriate, based on the measurement system available.

$$T_{\text{initial}} = (T_{\text{overhead}} + T_{\text{bottom}}) / 2 \quad (\text{Eq. Y-18c})$$

Where:

$T_{\text{initial}}$  = Average temperature of the delayed coking unit vessel when the drum is first vented to the atmosphere (°F).

$T_{\text{overhead}}$  = Temperature of the delayed coking unit vessel overhead line measured as near the coking unit vessel as practical just prior to venting to the atmosphere. If the temperature of the delayed coking unit vessel overhead line is less than 216 °F, use  $T_{\text{overhead}} = 216$  °F.

$T_{\text{bottom}}$  = Temperature of the delayed coking unit vessel near the bottom of the coke bed. If the temperature at the bottom of the coke bed is less than 212 °F, use  $T_{\text{bottom}} = 212$  °F.

$$T_{\text{initial}} = -0.039 P_{\text{overhead}}^2 + 3.13 P_{\text{overhead}} + 220 \quad (\text{Eq. Y-18d})$$

Where:

$T_{\text{initial}}$  = Average temperature of the delayed coking unit vessel when the drum is first vented to the atmosphere (°F).

$P_{\text{overhead}}$  = Pressure of the delayed coking unit vessel just prior to opening the atmospheric vent (pounds per square inch gauge, psig).

- (4) Determine the typical mass of steam generated and released per decoking cycle using Equation Y-18e of this section.

$$M_{\text{steam}} = \frac{(1 - f_{\text{ConvLoss}}) \times (M_{\text{water}} \times C_{p,\text{water}} + M_{\text{coke}} \times C_{p,\text{coke}}) \times (T_{\text{initial}} - T_{\text{final}})}{\Delta H_{\text{vap}}} \quad (\text{Eq. Y-18e})$$

Where:

$M_{\text{steam}}$  = Mass of steam generated and released per decoking cycle (metric tons/cycle).

$f_{\text{ConvLoss}}$  = fraction of total heat loss that is due to convective heat loss from the sides of the coke vessel (unitless). Use the default value of 0.10.

$M_{\text{water}}$  = Mass of water in the delayed coking unit vessel at the end of the cooling cycle just prior to atmospheric venting (metric tons/cycle).

$C_{p,\text{water}}$  = Heat capacity of water (British thermal units per metric ton per degree Fahrenheit; Btu/mt- °F). Use the default value of 2,205 Btu/mt- °F.

$M_{\text{coke}}$  = Typical dry mass of coke in the delayed coking unit vessel at the end of the coking cycle (metric tons/cycle) as determined in paragraph (i)(1) of this section.

$C_{p,\text{coke}}$  = Heat capacity of petroleum coke (Btu/mt- °F). Use the default value of 584 Btu/mt- °F.

$T_{\text{initial}}$  = Average temperature of the delayed coking unit vessel when the drum is first vented to the atmosphere (°F) as determined in paragraph (i)(3) of this section.

$T_{\text{final}}$  = Temperature of the delayed coking unit vessel when steam generation stops (°F). Use the default value of 212 °F.

$\Delta H_{\text{vap}}$  = Heat of vaporization of water (British thermal units per metric ton; Btu/mt). Use the default value of 2,116,000 Btu/mt.

- (5) Calculate the CH<sub>4</sub> emissions from decoking operations at each delayed coking unit using equation Y-18f to this section.

$$\text{CH}_4 = M_{\text{steam}} \times \text{EmF}_{\text{DCU}} \times N \times 0.001 \quad (\text{Eq. Y-18f})$$

Where:

CH<sub>4</sub> = Annual methane emissions from the delayed coking unit decoking operations (metric ton/year).

$M_{\text{steam}}$  = Mass of steam generated and released per decoking cycle (metric tons/cycle) as determined in paragraph (i)(4) of this section.

$\text{EmF}_{\text{DCU}}$  = Methane emission factor for delayed coking unit (kilograms CH<sub>4</sub> per metric ton of steam; kg CH<sub>4</sub>/mt steam) from unit-specific measurement data. If you do not have unit-specific measurement data, use the default value of 7.9 kg CH<sub>4</sub>/metric ton steam.

N = Cumulative number of decoking cycles (or coke-cutting cycles) for all delayed coking unit vessels associated with the delayed coking unit during the year.

0.001 = Conversion factor (metric ton/kg).

- (j) For each process vent not covered in paragraphs (a) through (i) of this section that can reasonably be expected to contain greater than 2 percent by volume CO<sub>2</sub> or greater than 0.5 percent by volume of CH<sub>4</sub> or greater than 0.01 percent by volume (100 parts per million) of N<sub>2</sub>O, calculate GHG emissions using Equation Y-19 of this section. You must also use Equation Y-19 of this section to calculate CH<sub>4</sub> emissions for catalytic reforming unit depressurization and purge vents when methane is used as the purge gas, and CO<sub>2</sub> and/or CH<sub>4</sub> emissions, as applicable, if you elected this method as an alternative to the methods in paragraph (f), (h), or (k) of this section.

$$E_x = \sum_{P=1}^N \left\{ (VR)_P \times (MF_x)_P \times \frac{MW_x}{MVC} \times (VT)_P \times 0.001 \right\} \quad (\text{Eq. Y-19})$$

Where:

$E_x$  = Annual emissions of each GHG from process vent (metric ton/yr).

N = Number of venting events per year.

P = Index of venting events.

$(VR)_p$  = Average volumetric flow rate of process gas during the event (scf per hour) from measurement data, process knowledge, or engineering estimates.

$(MF_x)_p$  = Mole fraction of GHG x in process vent during the event (kg-mol of GHG x/kg-mol vent gas) from measurement data, process knowledge, or engineering estimates.

$MW_x$  = Molecular weight of GHG x (kg/kg-mole); use 44 for CO<sub>2</sub> or N<sub>2</sub>O and 16 for CH<sub>4</sub>.

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

$(VT)_p$  = Venting time for the event, (hours).

0.001 = Conversion factor (metric ton/kg).

- (k) For uncontrolled blowdown systems, you must calculate CH<sub>4</sub> emissions either using the methods for process vents in paragraph (j) of this section regardless of the CH<sub>4</sub> concentration or using Equation Y-20 of this section. Blowdown systems where the uncondensed gas stream is routed to a flare or similar control device are considered to be controlled and are not required to estimate emissions under this paragraph (k).

$$CH_4 = \left( Q_{Ref} \times EF_{BD} \times \frac{16}{MVC} \times 0.001 \right) \quad (Eq. Y-20)$$

Where:

CH<sub>4</sub> = Methane emission rate from blowdown systems (mt CH<sub>4</sub>/year).

Q<sub>Ref</sub> = Quantity of crude oil plus the quantity of intermediate products received from off site that are processed at the facility (MMbbl/year).

EF<sub>BD</sub> = Methane emission factor for uncontrolled blown systems (scf CH<sub>4</sub>/MMbbl); default is 137,000.

16 = Molecular weight of CH<sub>4</sub> (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

0.001 = Conversion factor (metric ton/kg).

- (l) For equipment leaks, calculate CH<sub>4</sub> emissions using the method specified in either paragraph (l)(1) or (l)(2) of this section.
- (1) Use process-specific methane composition data (from measurement data or process knowledge) and any of the emission estimation procedures provided in the Protocol for Equipment Leak Emissions Estimates (EPA-453/R-95-017, NTIS PB96-175401).
  - (2) Use Equation Y-21 of this section.

$$CH_4 = (0.4 \times N_{CD} + 0.2 \times N_{PU1} + 0.1 \times N_{PU2} + 4.3 \times N_{H2} + 6 \times N_{FGS}) \quad (\text{Eq. Y-21})$$

Where:

$CH_4$  = Annual methane emissions from equipment leaks (metric tons/year).

$N_{CD}$  = Number of atmospheric crude oil distillation columns at the facility.

$N_{PU1}$  = Cumulative number of catalytic cracking units, coking units (delayed or fluid), hydrocracking, and full-range distillation columns (including depropanizer and debutanizer distillation columns) at the facility.

$N_{PU2}$  = Cumulative number of hydrotreating/hydrorefining units, catalytic reforming units, and visbreaking units at the facility.

$N_{H2}$  = Total number of hydrogen plants at the facility.

$N_{FGS}$  = Total number of fuel gas systems at the facility.

(m) For storage tanks, except as provided in paragraph (m)(3) of this section, calculate  $CH_4$  emissions using the applicable methods in paragraphs (m)(1) and (2) of this section.

(1) For storage tanks other than those processing unstabilized crude oil, you must either calculate  $CH_4$  emissions from storage tanks that have a vapor-phase methane concentration of 0.5 volume percent or more using tank-specific methane composition data (from measurement data or product knowledge) and the emission estimation methods provided in AP 42, Section 7.1 (incorporated by reference, see § 98.7) or estimate  $CH_4$  emissions from storage tanks using Equation Y-22 of this section.

$$CH_4 = (0.1 \times Q_{Ref}) \quad (\text{Eq. Y-22})$$

Where:

$CH_4$  = Annual methane emissions from storage tanks (metric tons/year).

0.1 = Default emission factor for storage tanks (metric ton  $CH_4$ /MMbbl).

$Q_{Ref}$  = Quantity of crude oil plus the quantity of intermediate products received from off site that are processed at the facility (MMbbl/year).

(2) For storage tanks that process unstabilized crude oil, calculate  $CH_4$  emissions from the storage of unstabilized crude oil using either tank-specific methane composition data (from measurement data or product knowledge) and direct measurement of the gas generation rate or by using Equation Y-23 of this section.

$$CH_4 = (995,000 \times Q_{un} \times \Delta P) \times MF_{CH_4} \times \frac{16}{MVC} \times 0.001 \quad (\text{Eq. Y-23})$$

Where:

$CH_4$  = Annual methane emissions from storage tanks (metric tons/year).

$Q_{un}$  = Quantity of unstabilized crude oil received at the facility (MMbbl/year).

$\Delta P$  = Pressure differential from the previous storage pressure to atmospheric pressure (pounds per square inch, psi).

$MF_{CH_4}$  = Average mole fraction of  $CH_4$  in vent gas from the unstabilized crude oil storage tanks from facility measurements (kg-mole  $CH_4$ /kg-mole gas); use 0.27 as a default if measurement data are not available.

995,000 = Correlation Equation factor (scf gas per MMbbl per psi).

16 = Molecular weight of  $CH_4$  (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf/kg-mole at 68 °F and 14.7 psia or 836.6 scf/kg-mole at 60 °F and 14.7 psia).

0.001 = Conversion factor (metric ton/kg).

(3) You do not need to calculate  $CH_4$  emissions from storage tanks that meet any of the following descriptions:

- (i) Units permanently attached to conveyances such as trucks, trailers, rail cars, barges, or ships;
- (ii) Pressure vessels designed to operate in excess of 204.9 kilopascals and without emissions to the atmosphere;
- (iii) Bottoms receivers or sumps;
- (iv) Vessels storing wastewater; or
- (v) Reactor vessels associated with a manufacturing process unit.

(n) For crude oil, intermediate, or product loading operations for which the vapor-phase concentration of methane is 0.5 volume percent or more, calculate  $CH_4$  emissions from loading operations using vapor-phase methane composition data (from measurement data or process knowledge) and the emission estimation procedures provided in AP 42, Section 5.2 (incorporated by reference, see § 98.7). For loading operations in which the vapor-phase concentration of methane is less than 0.5 volume percent, you may assume zero methane emissions.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79160, Dec. 17, 2010; 78 FR 71963, Nov. 29, 2013; 81 FR 89261, Dec. 9, 2016; 89 FR 31929, Apr. 25, 2024]

## § 98.254 Monitoring and QA/QC requirements.

(a) Fuel flow meters, gas composition monitors, and heating value monitors that are associated with sources that use a CEMS to measure  $CO_2$  emissions according to subpart C of this part or that are associated with stationary combustion sources must meet the applicable monitoring and QA/QC requirements in § 98.34.

- (b) All gas flow meters, gas composition monitors, and heating value monitors that are used to provide data for the GHG emissions calculations in this subpart for sources other than those subject to the requirements in paragraph (a) of this section shall be calibrated according to the procedures specified by the manufacturer, or according to the procedures in the applicable methods specified in paragraphs (c) through (g) of this section. In the case of gas flow meters, all gas flow meters must meet the calibration accuracy requirements in § 98.3(i). All gas flow meters, gas composition monitors, and heating value monitors must be recalibrated at the applicable frequency specified in paragraph (b)(1) or (b)(2) of this section.
  - (1) You must recalibrate each gas flow meter according to one of the following frequencies. You may recalibrate at the minimum frequency specified by the manufacturer, biennially (every two years), or at the interval specified by the industry consensus standard practice used.
  - (2) You must recalibrate each gas composition monitor and heating value monitor according to one of the following frequencies. You may recalibrate at the minimum frequency specified by the manufacturer, annually, or at the interval specified by the industry standard practice used.
- (c) For flare or sour gas flow meters and gas flow meters used to comply with the requirements in § 98.253(j), operate, calibrate, and maintain the flow meter according to one of the following. You may use the procedures specified by the flow meter manufacturer, or a method published by a consensus-based standards organization. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>).
- (d) Except as provided in paragraph (g) of this section, determine gas composition and, if required, average molecular weight of the gas using any of the following methods. Alternatively, the results of chromatographic or direct mass spectrometer analysis of the gas may be used, provided that the gas chromatograph or mass spectrometer is operated, maintained, and calibrated according to the manufacturer's instructions; and the methods used for operation, maintenance, and calibration of the gas chromatograph or mass spectrometer are documented in the written Monitoring Plan for the unit under § 98.3(g)(5).
  - (1) Method 18 at 40 CFR part 60, appendix A-6.
  - (2) ASTM D1945-03 Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (3) ASTM D1946-90 (Reapproved 2006) Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (4) GPA 2261-00 Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography (incorporated by reference, see § 98.7).
  - (5) UOP539-97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).

- (6) ASTM D2503-92 (Reapproved 2007) Standard Test Method for Relative Molecular Mass (Molecular Weight) of Hydrocarbons by Thermoelectric Measurement of Vapor Pressure (incorporated by reference, see § 98.7).
- (e) Determine flare gas higher heating value using any of the following methods. Alternatively, the results of chromatographic analysis of the gas may be used, provided that the gas chromatograph is operated, maintained, and calibrated according to the manufacturer's instructions; and the methods used for operation, maintenance, and calibration of the gas chromatograph are documented in the written Monitoring Plan for the unit under § 98.3(g)(5).
  - (1) ASTM D4809-06 Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method) (incorporated by reference, see § 98.7).
  - (2) ASTM D240-02 (Reapproved 2007) Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (incorporated by reference, see § 98.7).
  - (3) ASTM D1826-94 (Reapproved 2003) Standard Test Method for Calorific (Heating) Value of Gases in Natural Gas Range by Continuous Recording Calorimeter (incorporated by reference, see § 98.7).
  - (4) ASTM D3588-98 (Reapproved 2003) Standard Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels (incorporated by reference, see § 98.7).
  - (5) ASTM D4891-89 (Reapproved 2006) Standard Test Method for Heating Value of Gases in Natural Gas Range by Stoichiometric Combustion (incorporated by reference, see § 98.7).
- (f) For gas flow meters used to comply with the requirements in § 98.253(c)(2)(ii), install, operate, calibrate, and maintain each gas flow meter according to the requirements in 40 CFR 63.1572(c) and the following requirements.
  - (1) Locate the flow monitor at a site that provides representative flow rates. Avoid locations where there is swirling flow or abnormal velocity distributions due to upstream and downstream disturbances.
  - (2) [Reserved]
  - (3) Use a continuous monitoring system capable of correcting for the temperature, pressure, and moisture content to output flow in dry standard cubic feet (standard conditions as defined in § 98.6).
- (g) For exhaust gas CO<sub>2</sub>/CO/O<sub>2</sub> composition monitors used to comply with the requirements in § 98.253(c)(2), install, operate, calibrate, and maintain exhaust gas composition monitors according to the requirements in 40 CFR 60.105a(b)(2) or 40 CFR 63.1572(c) or according to the manufacturer's specifications and requirements.
- (h)-(i) [Reserved]
- (j) Determine the quantity of petroleum process streams using company records. These quantities include the quantity of coke produced per cycle, asphalt blown, quantity of crude oil plus the quantity of intermediate products received from off site, and the quantity of unstabilized crude oil received at the facility.
- (k) Determine temperature or pressure of delayed coking unit vessel using process instrumentation operated, maintained, and calibrated according to the manufacturer's instructions.



- (l) The owner or operator shall document the procedures used to ensure the accuracy of the estimates of fuel usage, gas composition, and heating value including but not limited to calibration of weighing equipment, fuel flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices shall also be recorded, and the technical basis for these estimates shall be provided.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79163, Dec. 17, 2010; 81 FR 89263, Dec. 9, 2016; 89 FR 31930, Apr. 25, 2024]

### § 98.255 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required (e.g., concentrations, flow rates, fuel heating values, carbon content values). Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a CEMS malfunctions during unit operation or if a required fuel sample is not taken), a substitute data value for the missing parameter shall be used in the calculations.

- (a) For stationary combustion sources, use the missing data procedures in subpart C of this part.
- (b) For each missing value of the heat content, carbon content, or molecular weight of the fuel, substitute the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If the “after” value is not obtained by the end of the reporting year, you may use the “before” value for the missing data substitution. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.
- (c) For missing CO<sub>2</sub>, CO, O<sub>2</sub>, CH<sub>4</sub>, or N<sub>2</sub>O concentrations, gas flow rate, and percent moisture, the substitute data values shall be the best available estimate(s) of the parameter(s), based on all available process data (e.g., processing rates, operating hours, etc.). The owner or operator shall document and keep records of the procedures used for all such estimates.
- (d) [Reserved]

[74 FR 56374, Oct. 30, 2009, as amended at 89 FR 31931, Apr. 25, 2024]

### § 98.256 Data reporting requirements.

In addition to the reporting requirements of § 98.3(c), you must report the information specified in paragraphs (a) through (q) of this section.

- (a) For combustion sources, follow the data reporting requirements under subpart C of this part (General Stationary Fuel Combustion Sources).
- (b)-(d) [Reserved]
- (e) For flares, owners and operators shall report:
  - (1) The flare ID number (if applicable).
  - (2) A description of the type of flare (steam assisted, air-assisted).
  - (3) A description of the flare service (general facility flare, unit flare, emergency only or back-up flare) and an indication of whether or not the flare is serviced by a flare gas recovery system.

- (4) The calculated CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O annual emissions for each flare, expressed in metric tons of each pollutant emitted.
  - (5) A description of the method used to calculate the CO<sub>2</sub> emissions for each flare (e.g., reference section and equation number).
  - (6) If you use Equation Y-1a in § 98.253, an indication of whether daily or weekly measurement periods are used, annual average carbon content of the flare gas (in kg carbon per kg flare gas), and, either the annual volume of flare gas combusted (in scf/year) and the annual average molecular weight (in kg/kg-mole), or the annual mass of flare gas combusted (in kg/yr).
  - (7) If you use Equation Y-1b of § 98.253, an indication of whether daily or weekly measurement periods are used, the annual volume of flare gas combusted (in scf/year), the annual average CO<sub>2</sub> concentration (volume or mole percent), the number of carbon containing compounds other than CO<sub>2</sub> in the flare gas stream, and for each of the carbon containing compounds other than CO<sub>2</sub> in the flare gas stream:
    - (i) The annual average concentration of the compound (volume or mole percent).
    - (ii) [Reserved]
  - (8) If you use Equation Y-2 of this subpart, an indication of whether daily or weekly measurement periods are used, the annual volume of flare gas combusted (in million (MM) scf/year), the annual average higher heating value of the flare gas (in mmBtu/mmscf), and an indication of whether the annual volume of flare gas combusted and the annual average higher heating value of the flare gas were determined using standard conditions of 68 °F and 14.7 psia or 60 °F and 14.7 psia.
  - (9) If you use Equation Y-3 of § 98.253, the number of SSM events exceeding 500,000 scf/day.
  - (10) The basis for the value of the fraction of carbon in the flare gas contributed by methane used in Equation Y-4 of § 98.253.
- (f) For catalytic cracking units, traditional fluid coking units, and catalytic reforming units, owners and operators shall report:
- (1) The unit ID number (if applicable).
  - (2) A description of the type of unit (fluid catalytic cracking unit, thermal catalytic cracking unit, traditional fluid coking unit, or catalytic reforming unit).
  - (3) Maximum rated throughput of the unit, in bbl/stream day.
  - (4) The calculated CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O annual emissions for each unit, expressed in metric tons of each pollutant emitted.
  - (5) A description of the method used to calculate the CO<sub>2</sub> emissions for each unit (e.g., reference section and equation number).
  - (6) If you use a CEMS, the relevant information required under § 98.36 for the Tier 4 Calculation Methodology, the CO<sub>2</sub> annual emissions as measured by the CEMS (unadjusted to remove CO<sub>2</sub> combustion emissions associated with additional units, if present) and the process CO<sub>2</sub> emissions as calculated according to § 98.253(c)(1)(ii). Report the CO<sub>2</sub> annual emissions associated with sources other than those from the coke burn-off in accordance with the applicable subpart (e.g., subpart C of this part in the case of a CO boiler).

- (7) If you use Equation Y-6 of § 98.253, the annual average exhaust gas flow rate, %CO<sub>2</sub>, and %CO.
  - (8) If you use Equation Y-7a of this subpart, the annual average flow rate of inlet air and oxygen-enriched air, %O<sub>2</sub>, %O<sub>oxy</sub>, %CO<sub>2</sub>, and %CO.
  - (9) If you use Equation Y-7b of this subpart, the annual average flow rate of inlet air and oxygen-enriched air, %N<sub>2,oxy</sub>, and %N<sub>2,exhaust</sub>.
  - (10) If you use Equation Y-8 of § 98.253, the basis for the value of the average carbon content of coke.
  - (11) Indicate whether you use a measured value, a unit-specific emission factor, or a default for CH<sub>4</sub> emissions. If you use a unit-specific emission factor for CH<sub>4</sub>, report the basis for the factor.
  - (12) Indicate whether you use a measured value, a unit-specific emission factor, or a default emission factor for N<sub>2</sub>O emissions. If you use a unit-specific emission factor for N<sub>2</sub>O, report the basis for the factor.
  - (13) If you use Equation Y-11 of § 98.253, the number of regeneration cycles or measurement periods during the reporting year and the average coke burn-off quantity per cycle or measurement period.
- (g) For fluid coking unit of the flexicoking type, the owner or operator shall report:
- (1) The unit ID number (if applicable).
  - (2) A description of the type of unit.
  - (3) Maximum rated throughput of the unit, in bbl/stream day.
  - (4) Indicate whether the GHG emissions from the low heat value gas are accounted for in subpart C of this part or § 98.253(c).
  - (5) If the GHG emissions for the low heat value gas are calculated at the flexicoking unit, also report the calculated annual CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions for each unit, expressed in metric tons of each pollutant emitted, and the applicable equation input parameters specified in paragraphs (f)(7) through (f)(13) of this section.
- (h) For on-site sulfur recovery plants and for emissions from sour gas sent off-site for sulfur recovery, the owner and operator shall report:
- (1) The plant ID number (if applicable).
  - (2) For each on-site sulfur recovery plant, the maximum rated throughput (metric tons sulfur produced/stream day), a description of the type of sulfur recovery plant, and an indication of the method used to calculate CO<sub>2</sub> annual emissions for the sulfur recovery plant (e.g., CO<sub>2</sub> CEMS, Equation Y-12, or process vent method in § 98.253(j)).
  - (3) The calculated CO<sub>2</sub> annual emissions for each on-site sulfur recovery plant, expressed in metric tons. The calculated annual CO<sub>2</sub> emissions from sour gas sent off-site for sulfur recovery, expressed in metric tons.
  - (4) [Reserved]
  - (5) If you recycle tail gas to the front of the sulfur recovery plant, indicate whether the recycled flow rate and carbon content are included in the measured data under § 98.253(f)(2) and (3). Indicate whether a correction for CO<sub>2</sub> emissions in the tail gas was used in Equation Y-12 of § 98.253. If so, then report:

(i) Indicate whether you used the default (95 percent) or a unit specific correction, and if a unit-specific correction was used, report the value of the correction and the approach used.

(ii) If the following data are not used to calculate the recycling correction factor, report the information specified in paragraphs (h)(5)(ii)(A) through (B) of this section.

(A) The annual volume of recycled tail gas (in scf/year).

(B) The annual average mole fraction of carbon in the tail gas (in kg-mole C/kg-mole gas).

(6) If you use a CEMS, the relevant information required under § 98.36 for the Tier 4 Calculation Methodology, the CO<sub>2</sub> annual emissions as measured by the CEMS and the annual process CO<sub>2</sub> emissions calculated according to § 98.253(f)(1). Report the CO<sub>2</sub> annual emissions associated with fuel combustion in accordance with subpart C of this part (General Stationary Fuel Combustion Sources).

(7) If you use the process vent method in § 98.253(j) for a non-Claus sulfur recovery plant, the relevant information required under paragraph (l)(5) of this section.

(i) [Reserved]

(j) For asphalt blowing operations, the owner or operator shall report:

(1) The unit ID number (if applicable).

(2) Maximum rated throughput of the unit, in metric tons asphalt/stream day.

(3) The type of control device used to reduce methane (and other organic) emissions from the unit.

(4) The calculated annual CO<sub>2</sub> and CH<sub>4</sub> emissions for each unit, expressed in metric tons of each pollutant emitted.

(5) If you use Equation Y-14 of § 98.253, the basis for the CO<sub>2</sub> emission factor used.

(6) If you use Equation Y-15 of § 98.253, the basis for the CH<sub>4</sub> emission factor used.

(7) If you use Equation Y-16a of § 98.253, the basis for the carbon emission factor used.

(8) If you use Equation Y-16b of § 98.253, the basis for the CO<sub>2</sub> emission factor used and the basis for the carbon emission factor used.

(9) If you use Equation Y-17 of § 98.253, the basis for the CH<sub>4</sub> emission factor used.

(10) If you use Equation Y-19 of this subpart, the relevant information required under paragraph (l)(5) of this section.

(k) For each delayed coking unit, the owner or operator shall report:

(1) The unit ID number (if applicable).

(2) Maximum rated throughput of the unit, in bbl/stream day.

(3) Annual quantity of coke produced in the unit during the reporting year, in metric tons.

(4) The calculated annual CH<sub>4</sub> emissions (in metric tons of CH<sub>4</sub>) for the delayed coking unit.

(5) The total number of delayed coking vessels (or coke drums) associated with the delayed coking unit.

- (6) The basis for the typical dry mass of coke in the delayed coking unit vessel at the end of the coking cycle (mass measurements from company records or calculated using equation Y-18a to § 98.253). If you use mass measurements from company records to determine the typical dry mass of coke in the delayed coking unit vessel at the end of the coking cycle, you must also report:
  - (i) Internal height of delayed coking unit vessel (feet) for each delayed coking unit.
  - (ii) Typical distance from the top of the delayed coking unit vessel to the top of the coke bed (i.e., coke drum outage) at the end of the coking cycle (feet) from company records or engineering estimates for each delayed coking unit.
- (7) An indication of the method used to estimate the average temperature of the coke bed,  $T_{\text{initial}}$  (overhead temperature and Equation Y-18c of this subpart or pressure correlation and Equation Y-18d of this subpart).
- (8) An indication of whether a unit-specific methane emissions factor or the default methane emission factor was used for the delayed coking unit.
- (l) For each process vent subject to § 98.253(j), the owner or operator shall report:
  - (1) The vent ID number (if applicable).
  - (2) The unit or operation associated with the emissions.
  - (3) The type of control device used to reduce methane (and other organic) emissions from the unit, if applicable.
  - (4) The calculated annual CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions for each vent, expressed in metric tons of each pollutant emitted.
  - (5) The annual volumetric flow discharged to the atmosphere (in scf), and an indication of the measurement or estimation method, annual average mole fraction of each GHG above the concentration threshold or otherwise required to be reported and an indication of the measurement or estimation method, and for intermittent vents, the number of venting events and the cumulative venting time.
- (m) For uncontrolled blowdown systems, the owner or operator shall report:
  - (1) An indication of whether the uncontrolled blowdown emission are reported under § 98.253(k) or § 98.253(j) or a statement that the facility does not have any uncontrolled blowdown systems.
  - (2) The cumulative annual CH<sub>4</sub> emissions (in metric tons of CH<sub>4</sub>) for uncontrolled blowdown systems.
  - (3) For uncontrolled blowdown systems reporting under § 98.253(k), the basis for the value of the methane emission factor used for uncontrolled blowdown systems.
  - (4) For uncontrolled blowdown systems reporting under § 98.253(j), the relevant information required under paragraph (l)(5) of this section.
- (n) For equipment leaks, the owner or operator shall report:
  - (1) The cumulative CH<sub>4</sub> emissions (in metric tons of each pollutant emitted) for all equipment leak sources.
  - (2) The method used to calculate the reported equipment leak emissions.
  - (3) The number of each type of emission source listed in Equation Y-21 of this subpart at the facility.

(o) For storage tanks, the owner or operator shall report:

(1) The cumulative annual CH<sub>4</sub> emissions (in metric tons of CH<sub>4</sub>) for all storage tanks, except for those used to process unstabilized crude oil.

(2) For storage tanks other than those processing unstabilized crude oil:

(i) The method used to calculate the reported storage tank emissions for storage tanks other than those processing unstabilized crude (i.e., either AP 42, Section 7.1 (incorporated by reference, see § 98.7), or Equation Y-22 of this section).

(ii) [Reserved]

(3) The cumulative CH<sub>4</sub> emissions (in metric tons of CH<sub>4</sub>) for storage tanks used to process unstabilized crude oil or a statement that the facility did not receive any unstabilized crude oil during the reporting year.

(4) For storage tanks that process unstabilized crude oil:

(i) The method used to calculate the reported unstabilized crude oil storage tank emissions.

(ii)-(iv) [Reserved]

(v) The basis for the mole fraction of CH<sub>4</sub> in vent gas from unstabilized crude oil storage tanks.

(vi) If you did not use Equation Y-23, the tank-specific methane composition data and the annual gas generation volume (scf/yr) used to estimate the cumulative CH<sub>4</sub> emissions for storage tanks used to process unstabilized crude oil.

(5)-(7) [Reserved]

(p) For loading operations, the owner or operator shall report:

(1) The cumulative annual CH<sub>4</sub> emissions (in metric tons of each pollutant emitted) for loading operations.

(2) The types of materials loaded that have an equilibrium vapor-phase concentration of methane of 0.5 volume percent or greater, and the type of vessel (barge, tanker, marine vessel, etc.) in which each type of material is loaded.

(3) The type of control system used to reduce emissions from the loading of material with an equilibrium vapor-phase concentration of methane of 0.5 volume percent or greater, if any (submerged loading, vapor balancing, etc.).

(q) Name of each method listed in § 98.254 or a description of manufacturer's recommended method used to determine a measured parameter.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79164, Dec. 17, 2010; 78 FR 71963, Nov. 29, 2013; 79 FR 63795, Oct. 24, 2014; 81 FR 89263, Dec. 9, 2016; 89 FR 31931, Apr. 25, 2024]

## § 98.257 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) and (b) of this section.

- (a) The records of all parameters monitored under § 98.255. If you comply with the combustion methodology in § 98.252(a), then you must retain under this subpart the records required for the Tier 3 and/or Tier 4 Calculation Methodologies in § 98.37 and you must keep records of the annual average flow calculations.
- (b) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (b)(1) through (73) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (b)(1) through (73) of this section.
  - (1) Volume of flare gas combusted during measurement period (scf) (Equation Y-1b of § 98.253).
  - (2) Mole percent CO<sub>2</sub> concentration in the flare gas stream during the measurement period (mole percent) (Equation Y-1b).
  - (3) Mole percent concentration of compound "x" in the flare gas stream during the measurement period (mole percent) (Equation Y-1b).
  - (4) Carbon mole number of compound "x" in the flare gas stream during the measurement period (mole carbon atoms per mole compound) (Equation Y-1b).
  - (5) Molar volume conversion factor (scf per kg-mole) (Equation Y-1b).
  - (6) Annual volume of flare gas combusted for each flare during normal operations from company records (million (MM) standard cubic feet per year, MMscf/year) (Equation Y-3 of § 98.253).
  - (7) Higher heating value for fuel gas or flare gas for each flare from company records (British thermal units per scf, Btu/scf = MMBtu/MMscf) (Equation Y-3).
  - (8) Volume of flare gas combusted during indexed start-up, shutdown, or malfunction event from engineering calculations (scf) (Equation Y-3).
  - (9) Average molecular weight of the flare gas, from the analysis results or engineering calculations for the event (kg/kg-mole) (Equation Y-3).
  - (10) Molar volume conversion factor (scf per kg-mole) (Equation Y-3).
  - (11) Average carbon content of the flare gas, from analysis results or engineering calculations for the event (kg C per kg flare gas) (Equation Y-3).
  - (12) Weight fraction of carbon in the flare gas prior to combustion in each flare that is contributed by methane from measurement values or engineering calculations (kg C in methane in flare gas/kg C in flare gas) (Equation Y-4 of § 98.253).
  - (13) Annual throughput of unit from company records for each catalytic cracking unit or fluid coking unit (barrels/year) (Equation Y-8 of § 98.253).
  - (14) Coke burn-off factor from engineering calculations (default for catalytic cracking units = 7.3; default for fluid coking units = 11) (kg coke per barrel of feed) (Equation Y-8).
  - (15) Carbon content of coke based on measurement or engineering estimate (kg C per kg coke) (Equation Y-8).
  - (16) Value of unit-specific CH<sub>4</sub> emission factor, including the units of measure, for each catalytic cracking unit, traditional fluid coking unit, and catalytic reforming unit (calculation method in § 98.253(c)(4)).

- (17) Annual activity data (e.g. , input or product rate), including the units of measure, in units of measure consistent with the emission factor, for each catalytic cracking unit, traditional fluid coking unit, and catalytic reforming unit (calculation method in § 98.253(c)(4)).
- (18) Value of unit-specific N<sub>2</sub>O emission factor, including the units of measure, for each catalytic cracking unit, traditional fluid coking unit, and catalytic reforming unit (calculation method in § 98.253(c)(5)).
- (19) Annual activity data (e.g. , input or product rate), including the units of measure, in units of measure consistent with the emission factor, for each catalytic cracking unit, traditional fluid coking unit, and catalytic reforming unit (calculation method in § 98.253(c)(5)).
- (20) Carbon content of coke based on measurement or engineering estimate (default = 0.94) (kg C per kg coke) (Equation Y-11 of § 98.253).
- (21) Volumetric flow rate of sour gas (including sour water stripper gas) feed sent off site for sulfur recovery in the year (scf/year) (Equation Y-12 of § 98.253).
- (22) Mole fraction of carbon in the sour gas feed sent off site for sulfur recovery (kg-mole C/kg-mole gas) (Equation Y-12).
- (23) Molar volume conversion factor for sour gas sent off site (scf per kg-mole) (Equation Y-12).
- (24) Volumetric flow rate of sour gas (including sour water stripper gas) fed to the onsite sulfur recovery plant (scf/year) (Equation Y-12).
- (25) Mole fraction of carbon in the sour gas fed to the onsite sulfur recovery plant (kg-mole C/kg-mole gas) (Equation Y-12).
- (26) Molar volume conversion factor for onsite sulfur recovery plant (scf per kg-mole) (Equation Y-12).
- (27)-(31) [Reserved]
- (32) Quantity of asphalt blown for each asphalt blowing unit (million barrels per year (MMbbl/year)) (Equation Y-14 of § 98.253).
- (33) Emission factor for CO<sub>2</sub> from uncontrolled asphalt blowing from facility-specific test data for each asphalt blowing unit (metric tons CO<sub>2</sub>/MMbbl asphalt blown) (Equation Y-14).
- (34) Emission factor for CH<sub>4</sub> from uncontrolled asphalt blowing from facility-specific test data for each asphalt blowing unit (metric tons CH<sub>4</sub>/MMbbl asphalt blown) (Equation Y-15 of § 98.253).
- (35) Quantity of asphalt blown (million barrels/year (MMbbl/year)) (Equation Y-16a of § 98.253).
- (36) Carbon emission factor from asphalt blowing from facility-specific test data (metric tons C/MMbbl asphalt blown) (Equation Y-16a).
- (37) Quantity of asphalt blown for each asphalt blowing unit (million barrels per year (MMbbl/year)) (Equation Y-16b of § 98.253).
- (38) Emission factor for CO<sub>2</sub> from uncontrolled asphalt blowing from facility-specific test data for each asphalt blowing unit (metric tons CO<sub>2</sub>/MMbbl asphalt blown) (Equation Y-16b).
- (39) Carbon emission factor from asphalt blowing from facility-specific test data for each asphalt blowing unit (metric tons C/MMbbl asphalt blown) (Equation Y-16b).
- (40) Emission factor for CH<sub>4</sub> from uncontrolled asphalt blowing from facility-specific test data for each asphalt blowing unit (metric tons CH<sub>4</sub>/MMbbl asphalt blown) (Equation Y-17 of § 98.253).



- (41) Typical dry mass of coke in the delayed coking unit vessel at the end of the coking cycle (metric tons/cycle) from company records or calculated using Equation Y-18a of this subpart (Equations Y-18a, Y-18b and Y-18e in § 98.253) for each delayed coking unit.
- (42) Internal height of delayed coking unit vessel (feet) (Equation Y-18a in § 98.253) for each delayed coking unit.
- (43) Typical distance from the top of the delayed coking unit vessel to the top of the coke bed (i.e., coke drum outage) at the end of the coking cycle (feet) from company records or engineering estimates (Equation Y-18a in § 98.253) for each delayed coking unit.
- (44) Diameter of delayed coking unit vessel (feet) (Equations Y-18a and Y-18b in § 98.253) for each delayed coking unit.
- (45) Mass of water in the delayed coking unit vessel at the end of the cooling cycle prior to atmospheric venting or draining (metric ton/cycle) (equations Y-18b and Y-18e to § 98.253) for each delayed coking unit.
- (46) Typical distance from the bottom of the coking unit vessel to the top of the water level at the end of the cooling cycle just prior to atmospheric venting or draining (feet) from company records or engineering estimates (equation Y-18b to § 98.253) for each delayed coking unit.
- (47) Mass of steam generated and released per decoking cycle (metric tons/cycle) (Equations Y-18e and Y-18f in § 98.253) for each delayed coking unit.
- (48) Average temperature of the delayed coking unit vessel when the drum is first vented to the atmosphere ( °F) (Equations Y-18c, Y-18d, and Y-18e in § 98.253) for each delayed coking unit.
- (49) Temperature of the delayed coking unit vessel overhead line measured as near the coking unit vessel as practical just prior to venting the atmosphere (Equation Y-18c in § 98.253) for each delayed coking unit.
- (50) Pressure of the delayed coking unit vessel just prior to opening the atmospheric vent (psig) (Equation Y-18d in § 98.253) for each delayed coking unit.
- (51) Methane emission factor for delayed coking unit (kilograms CH<sub>4</sub> per metric ton of steam; kg CH<sub>4</sub>/mt steam) (Equation Y-18f in § 98.253) for each delayed coking unit.
- (52) Cumulative number of decoking cycles (or coke-cutting cycles) for all delayed coking unit vessels associated with the delayed coking unit during the year (Equation Y-18f in § 98.253) for each delayed coking unit.
- (53) Fraction of the coke-filled bed that is covered by water at the end of the cooling cycle just prior to atmospheric venting or draining (equation Y-18b to § 98.253) for each delayed coking unit.
- (54)-(56) [Reserved]
- (57) Quantity of crude oil plus the quantity of intermediate products received from off site that are processed at the facility (MMbbl/year) (Equation Y-20 of § 98.253).
- (58) Molar volume conversion factor (scf per kg-mole) (Equation Y-20).
- (59) Methane emission factor for uncontrolled blown systems (scf CH<sub>4</sub>/MMbbl) (Equation Y-20).
- (60) Quantity of crude oil plus the quantity of intermediate products received from off site that are processed at the facility (MMbbl/year) (Equation Y-22 of § 98.253).

- (61) Quantity of unstabilized crude oil received at the facility (MMbbl/year) (Equation Y-23 of § 98.253).
- (62) Pressure differential from the previous storage pressure to atmospheric pressure (psi) (Equation Y-23).
- (63) Average mole fraction of CH<sub>4</sub> in vent gas from the unstabilized crude oil storage tanks from facility measurements (kg-mole CH<sub>4</sub>/kg-mole gas) (Equation Y-23).
- (64) Molar volume conversion factor (scf per kg-mole) (Equation Y-23).
- (65) Specify whether the calculated or default loading factor L specified in § 98.253(n) is entered, for each liquid loaded to each vessel (methods specified in § 98.253(n)).
- (66) Saturation factor specified in § 98.253(n), for each liquid loaded to each vessel (methods specified in § 98.253(n)).
- (67) True vapor pressure of liquid loaded, for each liquid loaded to each vessel (psia) (methods specified in § 98.253(n)).
- (68) Molecular weight of vapors (lb per lb-mole), for each liquid loaded to each vessel (methods specified in § 98.253(n)).
- (69) Temperature of bulk liquid loaded, for each liquid loaded to each vessel (°R, degrees Rankine) (methods specified in § 98.253(n)).
- (70) Total loading loss (without efficiency correction), for each liquid loaded to each vessel (pounds per 1000 gallons loaded) (methods specified in § 98.253(n)).
- (71) Overall emission control system reduction efficiency, including the vapor collection system efficiency and the vapor recovery or destruction efficiency (enter zero if no emission controls), for each liquid loaded to each vessel (percent) (methods specified § 98.253(n)).
- (72) Vapor phase concentration of methane in liquid loaded, for each liquid loaded to each vessel (percent by volume) (methods specified in § 98.253(n)).
- (73) Quantity of material loaded, for each liquid loaded to each vessel (thousand gallon per year) (methods specified in § 98.253(n)).

[79 FR 63796, Oct. 24, 2014, as amended at 81 FR 89263, Dec. 9, 2016; 89 FR 31931, Apr. 25, 2024]

## § 98.258 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart Z—Phosphoric Acid Production

### § 98.260 Definition of the source category.

The phosphoric acid production source category consists of facilities with a wet-process phosphoric acid process line used to produce phosphoric acid. A wet-process phosphoric acid process line is the production unit or units identified by an individual identification number in an operating permit and/or any process unit or group of process units at a facility reacting phosphate rock from a common supply source with acid.

## § 98.261 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a phosphoric acid production process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

## § 98.262 GHGs to report.

- (a) You must report CO<sub>2</sub> process emissions from each wet-process phosphoric acid process line.
- (b) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit following the requirements of subpart C of this part.

## § 98.263 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each wet-process phosphoric acid process line using the procedures in either paragraph (a) or (b) of this section.

- (a) Calculate and report under this subpart the process CO<sub>2</sub> emissions by operating and maintaining a CEMS according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart the process CO<sub>2</sub> emissions using the procedures in paragraphs (b)(1) and (b)(2) of this section.
  - (1) Calculate the annual CO<sub>2</sub> mass emissions from each wet-process phosphoric acid process line using the methods in paragraphs (b)(1)(i) or (ii) of this section, as applicable.
    - (i) If your process measurement provides the inorganic carbon content of phosphate rock as an output, calculate and report the process CO<sub>2</sub> emissions from each wet-process phosphoric acid process line using Equation Z-1a of this section:

$$E_m = \sum_{i=1}^b \sum_{n=1}^z (IC_{n,i} \cdot P_{n,i}) \cdot \frac{2000}{2205} \cdot \frac{44}{12} \quad (\text{Eq. Z-1a})$$

where:

$E_m$  = Annual CO<sub>2</sub> mass emissions from a wet-process phosphoric acid process line  $m$  according to this Equation Z-1a (metric tons).

$IC_{n,i}$  = Inorganic carbon content of a grab sample batch of phosphate rock by origin  $i$  obtained during month  $n$ , from the carbon analysis results (percent by weight, expressed as a decimal fraction).

$P_{n,i}$  = Mass of phosphate rock by origin  $i$  consumed in month  $n$  by wet-process phosphoric acid process line  $m$  (tons).

$z$  = Number of months during which the process line  $m$  operates.

$b$  = Number of different types of phosphate rock in month, by origin. If the grab sample is a composite sample of rock from more than one origin,  $b = 1$ .

2000/2205 = Conversion factor to convert tons to metric tons.

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

- (ii) If your process measurement provides the CO<sub>2</sub> content directly as an output, calculate and report the process CO<sub>2</sub> emissions from each wet-process phosphoric acid process line using Equation Z-1b of this section:

$$E_m = \sum_{i=1}^b \sum_{n=1}^z \left[ CO_{2ni} \cdot P_{ni} \right] \cdot \frac{2000}{2205} \quad (\text{Eq. Z-1b})$$

where:

$E_m$  = Annual CO<sub>2</sub> mass emissions from a wet-process phosphoric acid process line m according to this Equation Z-1b (metric tons).

$CO_{2ni}$  = Carbon dioxide content of a grab sample batch of phosphate rock by origin i obtained during month n (percent by weight, expressed as a decimal fraction).

$P_{ni}$  = Mass of phosphate rock by origin i consumed in month n by wet-process phosphoric acid process line m (tons).

z = Number of months during which the process line m operates.

b = Number of different types of phosphate rock in month, by origin. If the grab sample is a composite sample of rock from more than one origin, b = 1.

2000/2205 = Conversion factor to convert tons to metric tons.

- (2) You must determine the total emissions from the facility using Equation Z-2 of this section:

$$CO_2 = \sum_{m=1}^p E_m \quad (\text{Eq. Z-2})$$

Where:

CO<sub>2</sub> = Annual process CO<sub>2</sub> emissions from phosphoric acid production facility (metric tons/year).

$E_m$  = Annual process CO<sub>2</sub> emissions from wet-process phosphoric acid process line m (metric tons/year).

p = Number of wet-process phosphoric acid process lines.

- (c) If GHG emissions from a wet-process phosphoric acid process line are vented through the same stack as any combustion unit or process equipment that reports CO<sub>2</sub> emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate

process emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66468, Oct. 28, 2010; 78 FR 71964, Nov. 29, 2013]

### § 98.264 Monitoring and QA/QC requirements.

- (a) You must obtain a monthly grab sample of phosphate rock directly from the rock being fed to the process line before it enters the mill using one of the following methods. You may conduct the representative bulk sampling using a method published by a consensus standards organization, or you may use industry consensus standard practice methods, including but not limited to the Phosphate Mining States Methods Used and Adopted by the Association of Fertilizer and Phosphate Chemists (AFPC). If phosphate rock is obtained from more than one origin in a month, you must obtain a sample from each origin of rock or obtain a composite representative sample.
- (b) You must determine the carbon dioxide or inorganic carbon content of each monthly grab sample of phosphate rock (consumed in the production of phosphoric acid). You may use a method published by a consensus standards organization, or you may use industry consensus standard practice methods, including but not limited to the Phosphate Mining States Methods Used and Adopted by AFPC.
- (c) You must determine the mass of phosphate rock consumed each month (by origin) in each wet-process phosphoric acid process line. You can use existing plant procedures that are used for accounting purposes (such as sales records) or you can use data from existing monitoring equipment that is used to measure total mass flow of phosphorous-bearing feed under 40 CFR part 60 or part 63.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66468, Oct. 28, 2010; 78 FR 71964, Nov. 29, 2013]

### § 98.265 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter must be used in the calculations as specified in paragraphs (a) and (b) of this section.

- (a) For each missing value of the inorganic carbon content or CO<sub>2</sub> content of phosphate rock (by origin), you must use the appropriate default factor provided in Table Z-1 of this subpart. Alternatively, you must determine a substitute data value by calculating the arithmetic average of the quality-assured values of inorganic carbon contents or CO<sub>2</sub> contents of phosphate rock of origin i (see Equation Z-1a or Z-1b of this subpart) from samples immediately preceding and immediately following the missing data incident. If no quality-assured data on inorganic carbon contents or CO<sub>2</sub> contents of phosphate rock of origin i are available prior to the missing data incident, the substitute data value shall be the first quality-assured value for inorganic carbon contents or CO<sub>2</sub> contents for phosphate rock of origin i obtained after the missing data period.
- (b) For each missing value of monthly mass consumption of phosphate rock (by origin), you must use the best available estimate based on all available process data or data used for accounting purposes.

[78 FR 71964, Nov. 29, 2013]

## § 98.266 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (f) of this section.

- (a) Annual phosphoric acid production, by origin of the phosphate rock (tons).
- (b) Annual phosphoric acid production capacity (tons).
- (c) Annual arithmetic average percent inorganic carbon or carbon dioxide in phosphate rock from monthly records (percent by weight, expressed as a decimal fraction).
- (d) Annual phosphate rock consumption from monthly measurement records by origin (tons).
- (e) If you use a CEMS to measure CO<sub>2</sub> emissions, then you must report the information in paragraphs (e)(1) and (e)(2) of this section.
  - (1) The identification number of each wet-process phosphoric acid process line.
  - (2) The annual CO<sub>2</sub> emissions from each wet-process phosphoric acid process line (metric tons) and the relevant information required under 40 CFR 98.36 (e)(2)(vi) for the Tier 4 Calculation Methodology.
- (f) If you do not use a CEMS to measure emissions, then you must report the information in paragraphs (f)(1) through (9) of this section.
  - (1) Identification number of each wet-process phosphoric acid process line.
  - (2) Annual CO<sub>2</sub> emissions from each wet-process phosphoric acid process line (metric tons) as calculated by either Equation Z-1a or Equation Z-1b of this subpart.
  - (3) Annual phosphoric acid production capacity (tons) for each wet-process phosphoric acid process line.
  - (4) Method used to estimate any missing values of inorganic carbon content or carbon dioxide content of phosphate rock for each wet-process phosphoric acid process line.
  - (5) [Reserved]
  - (6) [Reserved]
  - (7) Number of wet-process phosphoric acid process lines.
  - (8) Number of times missing data procedures were used to estimate phosphate rock consumption (months), inorganic carbon contents of the phosphate rock (months), and CO<sub>2</sub> contents of the phosphate rock (months).
  - (9) Annual process CO<sub>2</sub> emissions from phosphoric acid production facility (metric tons).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66469, Oct. 28, 2010; 78 FR 71964, Nov. 29, 2013; 79 FR 63797, Oct. 24, 2014; 81 FR 89263, Dec. 9, 2016]

## § 98.267 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (d) of this section for each wet-process phosphoric acid production facility.

- (a) Monthly mass of phosphate rock consumed by origin (tons).
- (b) Records of all phosphate rock purchases and/or deliveries (if vertically integrated with a mine).
- (c) Documentation of the procedures used to ensure the accuracy of monthly phosphate rock consumption by origin.
- (d) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (4) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (4) of this section.

(1) Inorganic carbon content of a grab sample batch of phosphate rock by origin obtained during month by wet-process phosphoric acid process line, from the carbon analysis results (percent by weight, expressed as a decimal fraction) (Equation Z-1a of § 98.263).

(2) Mass of phosphate rock by origin consumed in month by wet-process phosphoric acid process line (tons) (Equation Z-1a).

(3) Carbon dioxide content of a grab sample batch of phosphate rock by origin obtained during month by wet-process phosphoric acid process line (percent by weight, expressed as a decimal fraction) (Equation Z-1b of § 98.263).

(4) Mass of phosphate rock by origin consumed in month by wet-process phosphoric acid process line (tons) (Equation Z-1b).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63797, Oct. 24, 2014]

§ 98.268 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71965, Nov. 29, 2013]

Table Z-1 to Subpart Z of Part 98—Default Chemical Composition of Phosphate Rock by Origin

| Origin                    | Total carbon<br>(percent by weight) |
|---------------------------|-------------------------------------|
| Central Florida           | 1.6                                 |
| North Florida             | 1.76                                |
| North Carolina (Calcined) | 0.76                                |
| Idaho (Calcined)          | 0.60                                |
| Morocco                   | 1.56                                |

Subpart AA—Pulp and Paper Manufacturing

### § 98.270 Definition of source category.

- (a) The pulp and paper manufacturing source category consists of facilities that produce market pulp (i.e., stand-alone pulp facilities), manufacture pulp and paper (i.e., integrated facilities), produce paper products from purchased pulp, produce secondary fiber from recycled paper, convert paper into paperboard products (e.g., containers), or operate coating and laminating processes.
- (b) The emission units for which GHG emissions must be reported are listed in paragraphs (b)(1) through (b)(5) of this section:
  - (1) Chemical recovery furnaces at kraft and soda mills (including recovery furnaces that burn spent pulping liquor produced by both the kraft and semichemical process).
  - (2) Chemical recovery combustion units at sulfite facilities.
  - (3) Chemical recovery combustion units at stand-alone semichemical facilities.
  - (4) Pulp mill lime kilns at kraft and soda facilities.
  - (5) Systems for adding makeup chemicals ( $\text{CaCO}_3$ ,  $\text{Na}_2\text{CO}_3$ ) in the chemical recovery areas of chemical pulp mills.

### § 98.271 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a pulp and paper manufacturing process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.272 GHGs to report.

You must report the emissions listed in paragraphs (a) through (f) of this section:

- (a)  $\text{CO}_2$ , biogenic  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  emissions from each kraft or soda chemical recovery furnace.
- (b)  $\text{CO}_2$ , biogenic  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  emissions from each sulfite chemical recovery combustion unit.
- (c)  $\text{CO}_2$ , biogenic  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  emissions from each stand-alone semichemical chemical recovery combustion unit.
- (d)  $\text{CO}_2$ , biogenic  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  emissions from each kraft or soda pulp mill lime kiln.
- (e)  $\text{CO}_2$  emissions from addition of makeup chemicals ( $\text{CaCO}_3$ ,  $\text{Na}_2\text{CO}_3$ ) in the chemical recovery areas of chemical pulp mills.
- (f)  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  combustion emissions from each stationary combustion unit. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

### § 98.273 Calculating GHG emissions.

- (a) For each chemical recovery furnace located at a kraft or soda facility, you must determine  $\text{CO}_2$ , biogenic  $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  emissions using the procedures in paragraphs (a)(1) through (4) of this section.  $\text{CH}_4$  and  $\text{N}_2\text{O}$  emissions must be calculated as the sum of emissions from combustion of fuels and combustion of biomass in spent liquor solids.



- (1) Calculate CO<sub>2</sub> emissions from fuel combustion using direct measurement of fuels consumed and default emissions factors according to the Tier 1 methodology for stationary combustion sources in § 98.33(a)(1). Tiers 2 or 3 from § 98.33(a)(2) or (3) may be used to calculate CO<sub>2</sub> emissions if the respective monitoring and QA/QC requirements described in § 98.34 are met.
- (2) Calculate CH<sub>4</sub> and N<sub>2</sub>O emissions from fuel combustion using direct measurement of fuels consumed, default or site-specific HHV, and default emissions factors and convert to metric tons of CO<sub>2</sub> equivalent according to the methodology for stationary combustion sources in § 98.33(c).
- (3) Calculate biogenic CO<sub>2</sub> emissions and emissions of CH<sub>4</sub> and N<sub>2</sub>O from biomass using measured quantities of spent liquor solids fired, site-specific HHV, and default emissions factors, according to equation AA-1 to this section:

$$\text{CO}_2, \text{CH}_4, \text{ or N}_2\text{O from biomass} = (0.90718) * \text{Solids} * \text{HHV} * \text{EF} \quad (\text{Eq. AA-1})$$

Where:

CO<sub>2</sub>, CH<sub>4</sub>, or N<sub>2</sub>O, from Biomass = Biogenic CO<sub>2</sub> emissions or emissions of CH<sub>4</sub> or N<sub>2</sub>O from spent liquor solids combustion (metric tons per year).

Solids = Mass of spent liquor solids combusted (short tons per year) determined according to § 98.274(b).

HHV = Annual high heat value of the spent liquor solids (mmBtu per kilogram) determined according to § 98.274(b).

EF = Default emission factor for CO<sub>2</sub>, CH<sub>4</sub>, or N<sub>2</sub>O, from table AA-1 to this subpart (kg CO<sub>2</sub>, CH<sub>4</sub>, or N<sub>2</sub>O per mmBtu).

0.90718 = Conversion factor from short tons to metric tons.

- (4) Calculate biogenic CO<sub>2</sub> emissions from combustion of biomass (other than spent liquor solids) with other fuels according to the applicable methodology for stationary combustion sources in § 98.33(e).
- (b) For each chemical recovery combustion unit located at a sulfite or stand-alone semichemical facility, you must determine CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions using the procedures in paragraphs (b)(1) through (5) of this section:
- (1) Calculate CO<sub>2</sub> emissions from fuel combustion using direct measurement of fuels consumed and default emissions factors according to the Tier 1 Calculation Methodology for stationary combustion sources in § 98.33(a)(1). Tiers 2 or 3 from § 98.33(a)(2) or (3) may be used to calculate CO<sub>2</sub> emissions if the respective monitoring and QA/QC requirements described in § 98.34 are met.
  - (2) Calculate CH<sub>4</sub> and N<sub>2</sub>O emissions from fuel combustion using direct measurement of fuels consumed, default or site-specific HHV, and default emissions factors and convert to metric tons of CO<sub>2</sub> equivalent according to the methodology for stationary combustion sources in § 98.33(c).
  - (3) Calculate biogenic CO<sub>2</sub> emissions using measured quantities of spent liquor solids fired and the carbon content of the spent liquor solids, according to equation AA-2 to this section:

$$\text{Biogenic CO}_2 = \frac{44}{12} * \text{Solids} * \text{CC} * (0.90718) \quad (\text{Eq. AA-2})$$

Where:

Biogenic CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions for spent liquor solids combustion (metric tons per year).

Solids = Mass of the spent liquor solids combusted (short tons per year) determined according to § 98.274(b).

CC = Annual carbon content of the spent liquor solids, determined according to § 98.274(b) (percent by weight, expressed as a decimal fraction, e.g., 95% = 0.95).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

0.90718 = Conversion from short tons to metric tons.

- (4) Calculate biogenic CO<sub>2</sub> emissions from combustion of biomass (other than spent liquor solids) with other fuels according to the applicable methodology for stationary combustion sources in § 98.33(e).
- (c) For each pulp mill lime kiln located at a kraft or soda facility, you must determine CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions using the procedures in paragraphs (c)(1) through (4) of this section:
  - (1) Calculate CO<sub>2</sub> emissions from fuel combustion using direct measurement of fuels consumed and default HHV and default emissions factors, according to the Tier 1 Calculation Methodology for stationary combustion sources in § 98.33(a)(1). Tiers 2 or 3 from § 98.33(a)(2) or (3) may be used to calculate CO<sub>2</sub> emissions if the respective monitoring and QA/QC requirements described in § 98.34 are met.
  - (2) Calculate CH<sub>4</sub> and N<sub>2</sub>O emissions from fuel combustion using direct measurement of fuels consumed, default or site-specific HHV, and default emissions factors and convert to metric tons of CO<sub>2</sub> equivalent according to the methodology for stationary combustion sources in § 98.33(c); use the default HHV listed in table C-1 to subpart C of this part and the default CH<sub>4</sub> and N<sub>2</sub>O emissions factors listed in table AA-2 to this subpart.
  - (3) Biogenic CO<sub>2</sub> emissions from conversion of CaCO<sub>3</sub> to CaO are included in the biogenic CO<sub>2</sub> estimates calculated for the chemical recovery furnace in paragraph (a)(3) of this section.
  - (4) Calculate biogenic CO<sub>2</sub> emissions from combustion of biomass with other fuels according to the applicable methodology for stationary combustion sources in § 98.33(e).
- (d) For makeup chemical use, you must calculate CO<sub>2</sub> emissions by using direct or indirect measurement of the quantity of chemicals added and ratios of the molecular weights of CO<sub>2</sub> and the makeup chemicals, according to equation AA-3 to this section:

$$CO_2 = \left[ M_{(CaCO_3)} * \frac{44}{100} + M_{(Na_2CO_3)} * \frac{44}{105.99} \right] * 1000 \text{ kg/metric ton} \quad (\text{Eq. AA-3})$$

Where:

CO<sub>2</sub> = CO<sub>2</sub> mass emissions from makeup chemicals (kilograms/yr).

M (CaCO<sub>3</sub>) = Make-up quantity of CaCO<sub>3</sub> used for the reporting year (metric tons per year).

M (Na<sub>2</sub>CO<sub>3</sub>) = Make-up quantity of Na<sub>2</sub>CO<sub>3</sub> used for the reporting year (metric tons per year).

44 = Molecular weight of CO<sub>2</sub>.

100 = Molecular weight of CaCO<sub>3</sub>.

105.99 = Molecular weight of Na<sub>2</sub>CO<sub>3</sub>.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79166, Dec. 17, 2010; 78 FR 71965, Nov. 29, 2013; 81 FR 89264, Dec. 9, 2016; 89 FR 31931, Apr. 25, 2024]

## § 98.274 Monitoring and QA/QC requirements.

- (a) Each facility subject to this subpart must quality assure the GHG emissions data according to the applicable requirements in § 98.34. All QA/QC data must be available for inspection upon request.
- (b) Fuel properties needed to perform the calculations in Equations AA-1 and AA-2 of this subpart must be determined according to paragraphs (b)(1) through (b)(3) of this section.
  - (1) High heat values of black liquor must be determined no less than annually using T684 om-06 Gross Heating Value of Black Liquor, TAPPI (incorporated by reference, see § 98.7). If measurements are performed more frequently than annually, then the high heat value used in Equation AA-1 of this subpart must be based on the average of the representative measurements made during the year.
  - (2) The annual mass of spent liquor solids must be determined using either of the methods specified in paragraph (b)(2)(i) or (b)(2)(ii) of this section.
    - (i) Measure the mass of spent liquor solids annually (or more frequently) using T-650 om-05 Solids Content of Black Liquor, TAPPI (incorporated by reference in § 98.7). If measurements are performed more frequently than annually, then the mass of spent liquor solids used in Equation AA-1 of this subpart must be based on the average of the representative measurements made during the year.
    - (ii) Determine the annual mass of spent liquor solids based on records of measurements made with an online measurement system that determines the mass of spent liquor solids fired in a chemical recovery furnace or chemical recovery combustion unit.
  - (3) Carbon analyses for spent pulping liquor must be determined no less than annually using ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7). If measurements using ASTM D5373-08 are performed more frequently than annually, then the spent pulping liquor carbon content used in Equation AA-2 of this subpart must be based on the average of the representative measurements made during the year.
- (c) Each facility must keep records that include a detailed explanation of how company records of measurements are used to estimate GHG emissions. The owner or operator must also document the procedures used to ensure the accuracy of the measurements of fuel, spent liquor solids, and makeup chemical usage, including, but not limited to calibration of weighing equipment, fuel flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must be recorded and the technical basis for these estimates must be provided. The procedures used to convert spent pulping liquor flow rates to units of mass (i.e., spent liquor solids firing rates) also must be documented.
- (d) Records must be made available upon request for verification of the calculations and measurements.

### § 98.275 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required sample is not taken), a substitute data value for the missing parameter shall be used in the calculations, according to the requirements of paragraphs (a) through (c) of this section:

- (a) There are no missing data procedures for measurements of heat content and carbon content of spent pulping liquor. A re-test must be performed if the data from any annual measurements are determined to be invalid.
- (b) For missing measurements of the mass of spent liquor solids or spent pulping liquor flow rates, use the lesser value of either the maximum mass or fuel flow rate for the combustion unit, or the maximum mass or flow rate that the fuel meter can measure. Alternatively, records of the daily spent liquor solids firing rate obtained to comply with § 63.866(c)(1) of this chapter may be used, adjusting for the duration of the missing measurements, as appropriate.
- (c) For the use of makeup chemicals (carbonates), the substitute data value shall be the best available estimate of makeup chemical consumption, based on available data (e.g., past accounting records, production rates). The owner or operator shall document and keep records of the procedures used for all such estimates.

[74 FR 56374, Oct. 30, 2009, as amended at 81 FR 89264, Dec. 9, 2016]

### § 98.276 Data reporting requirements.

In addition to the information required by § 98.3(c) and the applicable information required by § 98.36, each annual report must contain the information in paragraphs (a) through (l) of this section as applicable:

- (a) Annual emissions of CO<sub>2</sub>, biogenic CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O (metric tons per year).
- (b) [Reserved]
- (c) Basis for determining the annual mass of the spent liquor solids combusted (whether based on T650 om-05 Solids Content of Black Liquor, TAPPI (incorporated by reference, see § 98.7) or an online measurement system).
- (d) [Reserved]
- (e) The default emission factor for CO<sub>2</sub>, CH<sub>4</sub>, or N<sub>2</sub>O, used in Equation AA-1 of this subpart (kg CO<sub>2</sub>, CH<sub>4</sub>, or N<sub>2</sub>O per mmBtu).
- (f)-(i) [Reserved]
- (j) Annual steam purchases (pounds of steam per year).
- (k) Total annual production of unbleached virgin chemical pulp produced onsite during the reporting year in air-dried metric tons per year. This total annual production value is the sum of all kraft, semichemical, soda, and sulfite pulp produced onsite, prior to bleaching, through all virgin pulping lines. Do not include mechanical pulp or secondary fiber repulped for paper production in the virgin pulp production total.
- (l) For each pulp mill lime kiln, report the information specified in paragraphs (l)(1) and (2) of this section.

- (1) The quantity of calcium oxide (CaO) produced (metric tons).
- (2) The percent of annual heat input, individually for each fossil fuel type.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79166, Dec. 17, 2010; 78 FR 71965, Nov. 29, 2013; 79 FR 63797, Oct. 24, 2014; 89 FR 31932, Apr. 25, 2024]

## § 98.277 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the records in paragraphs (a) through (g) of this section.

- (a) GHG emission estimates (including separate estimates of biogenic CO<sub>2</sub>) for each emissions source listed under § 98.270(b).
- (b) Annual analyses of spent pulping liquor HHV for each chemical recovery furnace at kraft and soda facilities.
- (c) Annual analyses of spent pulping liquor carbon content for each chemical recovery combustion unit at a sulfite or semichemical pulp facility.
- (d) Annual quantity of spent liquor solids combusted in each chemical recovery furnace and chemical recovery combustion unit, and the basis for determining the annual quantity of the spent liquor solids combusted (whether based on T650 om-05 Solids Content of Black Liquor, TAPPI (incorporated by reference, see § 98.7) or an online measurement system). If an online measurement system is used, you must retain records of the calculations used to determine the annual quantity of spent liquor solids combusted from the continuous measurements.
- (e) Annual steam purchases.
- (f) Annual quantities of makeup chemicals used.
- (g) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (g)(1) through (27) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (g)(1) through (27) of this section.
  - (1) Mass of the solid fuel combusted (tons/year) (Equation C-1 of § 98.33).
  - (2) Volume of the liquid fuel combusted (gallons/year) (Equation C-1).
  - (3) Volume of the gaseous fuel combusted (scf/year) (Equation C-1).
  - (4) Annual natural gas usage (therms/year) (Equation C-1a of § 98.33).
  - (5) Annual natural gas usage (mmBtu/year) (Equation C-1b of § 98.33).
  - (6) Mass of the solid fuel combusted (tons/year) (Equation C-2a of § 98.33).
  - (7) Volume of the liquid fuel combusted (gallons/year) (Equation C-2a).
  - (8) Volume of the gaseous fuel combusted (scf/year) (Equation C-2a).
  - (9) Annual mass of the solid fuel combusted (short tons/year) (Equation C-3 of § 98.33).

- (10) Annual average carbon content of the solid fuel (percent by weight, expressed as a decimal fraction) (Equation C-3).
- (11) Annual volume of the liquid fuel combusted (gallons/year) (Equation C-4 of § 98.33).
- (12) Annual average carbon content of the liquid fuel (kg C per gallon of fuel) (Equation C-4).
- (13) Annual volume of the gaseous fuel combusted (scf/year) (Equation C-5 of § 98.33).
- (14) Annual average carbon content of the gaseous fuel (kg C per kg of fuel) (Equation C-5).
- (15) Annual average molecular weight of the gaseous fuel (kg/kg-mole) (Equation C-5).
- (16) Molar volume conversion factor at standard conditions, as defined in § 98.6 (scf per kg-mole) (Equation C-5).
- (17) Identify if you will use the default high heat value from Table C-1 of subpart C of this part, or actual HHV data (Equation C-8 of § 98.33).
- (18) High heat value of the fuel (mmBTU/tons) (Equation C-8).
- (19) High heat value of the fuel (mmBTU/gallons) (Equation C-8).
- (20) High heat value of the fuel (mmBTU/scf) (Equation C-8).
- (21) Mass of spent liquor solids combusted from each chemical recovery furnace located at a kraft or soda facility, in short tons in year, determined according to § 98.274(b) (tons/year) (Equation AA-1 of § 98.273).
- (22) Annual high heat value of the spent liquor solids from each chemical recovery furnace located at a kraft or soda facility determined according to § 98.274(b) (mmBtu per kilogram) (Equation AA-1).
- (23) Annual high heat value of the spent liquor solids from each chemical recovery combustion unit located at a sulfite or stand-alone semichemical facility, determined according to § 98.274(b) (mmBtu per kilogram) (Equation AA-1).
- (24) Mass of the spent liquor solids combusted in short tons per year determined according to § 98.274(b) (tons/year) (Equation AA-2 of § 98.273).
- (25) Annual carbon content of the spent liquor solids, determined according to § 98.274(b) (percent by weight, expressed as a decimal fraction (e.g., 95% = 0.95)) (Equation AA-2).
- (26) Make-up quantity of  $\text{CaCO}_3$  used for the reporting year (metric tons/year) (Equation AA-3 of § 98.273).
- (27) Make-up quantity of  $\text{Na}_2\text{CO}_3$  used for the reporting year metric tons/year) (Equation AA-3).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63798, Oct. 24, 2014; 89 FR 31932, Apr. 25, 2024]

## § 98.278 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Table AA-1 to Subpart AA of Part 98—Kraft Pulping Liquor Emissions Factors for Biomass-Based CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O**

| Wood furnish            | Biomass-based emissions factors<br>(kg/mmBtu HHV) |                 |                  |
|-------------------------|---------------------------------------------------|-----------------|------------------|
|                         | <sup>a</sup> CO <sub>2</sub>                      | CH <sub>4</sub> | N <sub>2</sub> O |
| North American Softwood | 94.4                                              | 0.0019          | 0.00042          |
| North American Hardwood | 93.7                                              | 0.0019          | 0.00042          |
| Bagasse                 | 95.5                                              | 0.0019          | 0.00042          |
| Bamboo                  | 93.7                                              | 0.0019          | 0.00042          |
| Straw                   | 95.1                                              | 0.0019          | 0.00042          |

<sup>a</sup> Includes emissions from both the recovery furnace and pulp mill lime kiln.

[78 FR 71965, Nov. 29, 2013]

**Table AA-2 to Subpart AA of Part 98—Kraft Lime Kiln and Calciner Emissions Factors for CH<sub>4</sub> and N<sub>2</sub>O**

| Fuel                      | Fossil fuel-based emissions factors (kg/mmBtu HHV) |                  |                              |                  |
|---------------------------|----------------------------------------------------|------------------|------------------------------|------------------|
|                           | Kraft rotary lime kilns                            |                  | Kraft calciners <sup>a</sup> |                  |
|                           | CH <sub>4</sub>                                    | N <sub>2</sub> O | CH <sub>4</sub>              | N <sub>2</sub> O |
| Residual Oil (any type)   | 0.0027                                             | 0                | 0.0027                       | 0.0003           |
| Distillate Oil (any type) | 0.0027                                             | 0                | 0.0027                       | 0.0004           |
| Natural Gas               | 0.0027                                             | 0                | 0.0027                       | 0.0001           |
| Biogas                    | 0.0027                                             | 0                | 0.0027                       | 0.0001           |
| Petroleum coke            | 0.0027                                             | 0                | <sup>b</sup> NA              | <sup>b</sup> NA  |
| Other Fuels               | See Table C-2                                      | 0                | See Table C-2                | See Table C-2    |

<sup>a</sup> Includes, for example, fluidized bed calciners at kraft mills.

<sup>b</sup> Emission factors for kraft calciners are not available.

[78 FR 71965, Nov. 29, 2013, as amended at 81 FR 89264, Dec. 9, 2016]

## Subpart BB—Silicon Carbide Production

### § 98.280 Definition of the source category.

Silicon carbide production includes any process that produces silicon carbide for abrasive purposes.

### § 98.281 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a silicon carbide production process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.282 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from all silicon carbide process units or furnaces combined.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71966, Nov. 29, 2013]

### § 98.283 Calculating GHG emissions.

You must calculate and report the combined annual process CO<sub>2</sub> emissions from all silicon carbide process units and production furnaces using the procedures in either paragraph (a) or (b) of this section.

- (a) Calculate and report under this subpart the combined annual process CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart the combined annual process CO<sub>2</sub> emissions using the procedures in paragraphs (b)(1) and (b)(2) of this section.
  - (1) Use Equation BB-1 of this section to calculate the facility-specific emissions factor for determining CO<sub>2</sub> emissions. The carbon content must be measured monthly and used to calculate a monthly CO<sub>2</sub> emissions factor:

$$EF_{CO_2,n} = 0.65 \cdot CCF_n \cdot \left( \frac{44}{12} \right) \quad (\text{Eq. BB-1})$$

Where:

$EF_{CO_2,n}$  = CO<sub>2</sub> emissions factor in month n (metric tons CO<sub>2</sub>/metric ton of petroleum coke consumed).

0.65 = Adjustment factor for the amount of carbon in silicon carbide product (assuming 35 percent of carbon input is in the carbide product).

$CCF_n$  = Carbon content factor for petroleum coke consumed in month n from the supplier or as measured by the applicable method incorporated by reference in § 98.7 according to § 98.284(c) (percent by weight expressed as a decimal fraction).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.



- (2) Calculate annual CO<sub>2</sub> process emissions from the silicon carbide production facility according to Equation BB-2 of this section:

$$CO_2 = \sum_{n=1}^{12} [T_n \cdot EF_{CO_2,n}] \cdot \frac{2000}{2205} \quad (\text{Eq. BB-2})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions from silicon carbide production facility (metric tons CO<sub>2</sub>).

T<sub>n</sub> = Petroleum coke consumption in calendar month n (tons).

EF<sub>CO<sub>2</sub>,n</sub> = CO<sub>2</sub> emissions factor from month n (calculated in Equation BB-1 of this section).

2000/2205 = Conversion factor to convert tons to metric tons.

n = Number of month.

- (c) If GHG emissions from a silicon carbide production furnace or process unit are vented through the same stack as any combustion unit or process equipment that reports CO<sub>2</sub> emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate process emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71966, Nov. 29, 2013]

## § 98.284 Monitoring and QA/QC requirements.

- (a) You must measure your consumption of petroleum coke using plant instruments used for accounting purposes including direct measurement weighing the petroleum coke fed into your process (by belt scales or a similar device) or through the use of purchase records.
- (b) You must document the procedures used to ensure the accuracy of monthly petroleum coke consumption measurements.
- (c) For CO<sub>2</sub> process emissions, you must determine the monthly carbon content of the petroleum coke using reports from the supplier. Alternatively, facilities can measure monthly carbon contents of the petroleum coke using ASTM D3176-89 (Reapproved 2002) Standard Practice for Ultimate Analysis of Coal and Coke (incorporated by reference, see § 98.7) and ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7).
- (d) For quality assurance and quality control of the supplier data, you must conduct an annual measurement of the carbon content of the petroleum coke using ASTM D3176-89 and ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7).

### § 98.285 Procedures for estimating missing data.

For the petroleum coke input procedure in § 98.283(b), a complete record of all measured parameters used in the GHG emissions calculations is required (e.g., carbon content values, etc.). Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in the paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) For each missing value of the monthly carbon content of petroleum coke, the substitute data value shall be the arithmetic average of the quality-assured values of carbon contents immediately preceding and immediately following the missing data incident. If no quality-assured data on carbon contents are available prior to the missing data incident, the substitute data value shall be the first quality-assured value for carbon contents obtained after the missing data period.
- (b) For each missing value of the monthly petroleum coke consumption, the substitute data value shall be the best available estimate of the petroleum coke consumption based on all available process data or information used for accounting purposes (such as purchase records).

### § 98.286 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraph (a) or (b) of this section, and paragraph (c) of this section, as applicable for each silicon carbide production facility.

- (a) If a CEMS is used to measure process CO<sub>2</sub> emissions, you must report under this subpart the relevant information required for the Tier 4 Calculation Methodology in § 98.36 and the information listed in this paragraph (a):
  - (1) Annual consumption of petroleum coke (tons).
  - (2) Annual production of silicon carbide (tons).
  - (3) Annual production capacity of silicon carbide (tons).
- (b) If a CEMS is not used to measure process CO<sub>2</sub> emissions, you must report the information in paragraph (b)(1) through (8) of this section for all silicon carbide process units or production furnaces combined:
  - (1) [Reserved]
  - (2) **Annual production of** silicon carbide (tons).
  - (3) Annual production capacity of silicon carbide (tons).
  - (4) [Reserved]
  - (5) Whether carbon content of the petroleum coke is based on reports from the supplier or through self measurement using applicable ASTM standard method.
  - (6) [Reserved]
  - (7) Sampling analysis results for carbon content of consumed petroleum coke as determined for QA/QC of supplier data under § 98.284(d) (percent by weight expressed as a decimal fraction).

- (8) Number of times in the reporting year that missing data procedures were followed to measure the carbon contents of petroleum coke (number of months) and petroleum coke consumption (number of months).
- (c) If methane abatement technology is used at the silicon carbide production facility, you must report the information in paragraphs (c)(1) through (3) of this section. Upon reporting this information once in an annual report, you are not required to report this information again unless the information changes during a reporting year, in which case, the reporter must include any updates in the annual report for the reporting year in which the change occurred.
  - (1) Type of methane abatement technology used on each silicon carbide process unit or production furnace, and date of installation for each.
  - (2) Methane destruction efficiency for each methane abatement technology (percent destruction). You must either use the manufacturer's specified destruction efficiency or the destruction efficiency determined via a performance test. If you report the destruction efficiency determined via a performance test, you must also report the test method that was used during the performance test.
  - (3) Percentage of annual operating hours that methane abatement technology was in use for all silicon carbide process units or production furnaces combined.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71966, Nov. 29, 2013; 79 FR 63798, Oct. 24, 2014; 89 FR 31932, Apr. 25, 2024]

### § 98.287 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (d) of this section for each silicon carbide production facility.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37 and the information listed in this paragraph (a):
  - (1) Records of all petroleum coke purchases.
  - (2) Annual operating hours.
- (b) If a CEMS is not used to measure emissions, you must retain records for the information listed in this paragraph (b):
  - (1) Records of all analyses and calculations conducted for reported data listed in § 98.286(b).
  - (2) Records of all petroleum coke purchases.
  - (3) Annual operating hours.
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) and (2) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) and (2) of this section.
  - (1) Carbon content factor for petroleum coke consumed in month from the supplier or as measured by the applicable method (percent by weight expressed as a decimal fraction) (Equation BB-1 of § 98.283).
  - (2) Petroleum coke consumption in month (tons) (Equation BB-2 of § 98.283).

- (d) Records of all information reported as required under § 98.286(c).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63798, Oct. 24, 2014; 89 FR 31933, Apr. 25, 2024]

## § 98.288 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart CC—Soda Ash Manufacturing

### § 98.290 Definition of the source category.

- (a) A soda ash manufacturing facility is any facility with a manufacturing line that produces soda ash by one of the methods in paragraphs (a)(1) through (3) of this section:
- (1) Calcining trona.
  - (2) Calcining sodium sesquicarbonate.
  - (3) Using a liquid alkaline feedstock process that directly produces CO<sub>2</sub>.
- (b) In the context of the soda ash manufacturing sector, “calcining” means the thermal/chemical conversion of the bicarbonate fraction of the feedstock to sodium carbonate.

### § 98.291 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a soda ash manufacturing process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.292 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from each soda ash manufacturing line combined.
- (b) CO<sub>2</sub> combustion emissions from each soda ash manufacturing line.
- (c) CH<sub>4</sub> and N<sub>2</sub>O combustion emissions from each soda ash manufacturing line. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (d) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit other than soda ash manufacturing lines. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

### § 98.293 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each soda ash manufacturing line using the procedures specified in paragraph (a) or (b) of this section.

- (a) For each soda ash manufacturing line that meets the conditions specified in § 98.33(b)(4)(ii) or (b)(4)(iii), you must calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) For each soda ash manufacturing line that is not subject to the requirements in paragraph (a) of this section, calculate and report the process CO<sub>2</sub> emissions from the soda ash manufacturing line by using the procedure in either paragraphs (b)(1), (b)(2), or (b)(3) of this section; and the combustion CO<sub>2</sub> emissions using the procedure in paragraph (b)(4) of this section.
  - (1) Calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
  - (2) Use either Equation CC-1 or Equation CC-2 of this section to calculate annual CO<sub>2</sub> process emissions from each manufacturing line that calcines trona to produce soda ash:

$$E_k = \sum_{n=1}^{12} [(IC_T)_n \cdot (T_t)_n] \cdot \frac{2000}{2205} \cdot \frac{0.097}{1} \quad (\text{Eq. CC-1})$$

$$E_k = \sum_{n=1}^{12} [(IC_{sa})_n \cdot (T_{sa})_n] \cdot \frac{2000}{2205} \cdot \frac{0.138}{1} \quad (\text{Eq. CC-2})$$

Where:

$E_k$  = Annual CO<sub>2</sub> process emissions from each manufacturing line, k (metric tons).

$(IC_T)_n$  = Inorganic carbon content (percent by weight, expressed as a decimal fraction) in trona input, from the carbon analysis results for month n. This represents the ratio of trona to trona ore.

$(IC_{sa})_n$  = Inorganic carbon content (percent by weight, expressed as a decimal fraction) in soda ash output, from the carbon analysis results for month n. This represents the purity of the soda ash produced.

$(T_t)_n$  = Mass of trona input in month n (tons).

$(T_{sa})_n$  = Mass of soda ash output in month n (tons).

2000/2205 = Conversion factor to convert tons to metric tons.

0.097/1 = Ratio of ton of CO<sub>2</sub> emitted for each ton of trona.

0.138/1 = Ratio of ton of CO<sub>2</sub> emitted for each ton of soda ash produced.

- (3) **Site-specific emission factor method.** Use Equations CC-3, CC-4, and CC-5 of this section to determine annual CO<sub>2</sub> process emissions from manufacturing lines that use the liquid alkaline feedstock process to produce soda ash. You must conduct an annual performance test and measure CO<sub>2</sub> emissions and flow rates at all process vents from the mine water stripper/evaporator for each manufacturing line and calculate CO<sub>2</sub> emissions as described in paragraphs (b)(3)(i) through (b)(3)(iv) of this section.
- (i) During the performance test, you must measure the process vent flow from each process vent during the test and calculate the average rate for the test period in metric tons per hour.
  - (ii) Using the test data, you must calculate the hourly CO<sub>2</sub> emission rate using Equation CC-3 of this section:

$$ER_{CO_2} = [(C_{CO_2} \cdot 10000) \cdot 2.59 \times 10^{-9} \cdot 44] \cdot (Q \cdot 60) \cdot 4.53 \times 10^{-4} \quad (\text{Eq. CC-3})$$

Where:

$ER_{CO_2}$  = CO<sub>2</sub> mass emission rate (metric tons/hour).

$C_{CO_2}$  = Hourly CO<sub>2</sub> concentration (percent CO<sub>2</sub>) as determined by § 98.294(c).

10000 = Parts per million per percent

$2.59 \times 10^{-9}$  = Conversion factor (pounds-mole/dscf/ppm).

44 = Pounds per pound-mole of carbon dioxide.

Q = Stack gas volumetric flow rate per minute (dscfm).

60 = Minutes per hour

$4.53 \times 10^{-4}$  = Conversion factor (metric tons/pound)

- (iii) Using the test data, you must calculate a CO<sub>2</sub> emission factor for the process using Equation CC-4 of this section:

$$EF_{CO_2} = \frac{ER_{CO_2}}{(V_r \cdot 4.53 \times 10^{-4})} \quad (\text{Eq. CC-4})$$

Where:

$EF_{CO_2}$  = CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub>/metric ton of process vent flow from mine water stripper/evaporator).

$ER_{CO_2}$  = CO<sub>2</sub> mass emission rate (metric tons/hour).

$V_t$  = Process vent flow rate from mine water stripper/evaporator during annual performance test (pounds/hour).

$4.53 \times 10^{-4}$  = Conversion factor (metric tons/pound)

- (iv) You must calculate annual CO<sub>2</sub> process emissions from each manufacturing line using Equation CC-5 of this section:

$$E_k = EF_{CO_2} * (V_a * 0.453) * H \quad (\text{Eq. CC-5})$$

Where:

$E_k$  = Annual CO<sub>2</sub> process emissions for each manufacturing line, k (metric tons).

$EF_{CO_2}$  = CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub>/metric ton of process vent flow from mine water stripper/evaporator).

$V_a$  = Annual process vent flow rate from mine water stripper/evaporator (thousand pounds/hour).

H = Annual operating hours for the each manufacturing line.

0.453 = Conversion factor (metric tons/thousand pounds).

- (4) Calculate and report under subpart C of this part (General Stationary Fuel Combustion Sources) the combustion CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions in the soda ash manufacturing line according to the applicable requirements in subpart C.

## § 98.294 Monitoring and QA/QC requirements.

Section 98.293 provides three different procedures for emission calculations. The appropriate paragraphs (a) through (c) of this section should be used for the procedure chosen.

- (a) If you determine your emissions using § 98.293(b)(2) (Equation CC-1 of this subpart) you must:
- (1) Determine the monthly inorganic carbon content of the trona from a weekly composite analysis for each soda ash manufacturing line, using a modified version of ASTM E359-00 (Reapproved 2005)e1, Standard Test Methods for Analysis of Soda Ash (Sodium Carbonate) (incorporated by reference, see § 98.7). ASTM E359-00(Reapproved 2005) e1 is designed to measure the total alkalinity in soda ash not in trona. The modified method referred to above adjusts the regular ASTM method to express the results in terms of trona. Although ASTM E359-00 (Reapproved 2005) e1 uses manual titration, suitable autotitrators may also be used for this determination.
  - (2) Measure the mass of trona input to each soda ash manufacturing line on a monthly basis using belt scales or methods used for accounting purposes.
  - (3) Document the procedures used to ensure the accuracy of the monthly measurements of trona consumed.
- (b) If you calculate CO<sub>2</sub> process emissions based on soda ash production (§ 98.293(b)(2) Equation CC-2 of this subpart), you must:

- (1) Determine the inorganic carbon content of the soda ash (i.e., soda ash purity) using ASTM E359-00 (Reapproved 2005) e1 Standard Test Methods for Analysis of Soda Ash (Sodium Carbonate) (incorporated by reference, see § 98.7). Although ASTM E359-00 (Reapproved 2005) e1 uses manual titration, suitable autotitrators may also be used for this determination.
  - (2) Measure the mass of soda ash produced by each soda ash manufacturing line on a monthly basis using belt scales, by weighing the soda ash at the truck or rail loadout points of your facility, or methods used for accounting purposes.
  - (3) Document the procedures used to ensure the accuracy of the monthly measurements of soda ash produced.
- (c) If you calculate CO<sub>2</sub> emissions using the site-specific emission factor method in § 98.293(b)(3), you must:
- (1) Conduct an annual performance test that is based on representative performance (i.e., performance based on normal operating conditions) of the affected process.
  - (2) Sample the stack gas and conduct three emissions test runs of 1 hour each.
  - (3) Conduct the stack test using EPA Method 3A at 40 CFR part 60, appendix A-2 to measure the CO<sub>2</sub> concentration, Method 2, 2A, 2C, 2D, or 2F at 40 CFR part 60, appendix A-1 or Method 26 at 40 CFR part 60, appendix A-2 to determine the stack gas volumetric flow rate. All QA/QC procedures specified in the reference test methods and any associated performance specifications apply. For each test, the facility must prepare an emission factor determination report that must include the items in paragraphs (c)(3)(i) through (c)(3)(iii) of this section.
    - (i) Analysis of samples, determination of emissions, and raw data.
    - (ii) All information and data used to derive the emissions factor(s).
    - (iii) You must determine the average process vent flow rate from the mine water stripper/evaporater during each test and document how it was determined.
  - (4) You must also determine the annual vent flow rate from the mine water stripper/evaporater from monthly information using the same plant instruments or procedures used for accounting purposes (i.e., volumetric flow meter).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66469, Oct. 28, 2010; 81 FR 89264, Dec. 9, 2016]

### § 98.295 Procedures for estimating missing data.

For the emission calculation methodologies in § 98.293(b)(2) and (b)(3), a complete record of all measured parameters used in the GHG emissions calculations is required (e.g., inorganic carbon content values, etc.). Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in the paragraphs (a) through (d) of this section. You must document and keep records of the procedures used for all such missing value estimates.

- (a) For each missing value of the weekly composite of inorganic carbon content of either soda ash or trona, the substitute data value shall be the arithmetic average of the quality-assured values of inorganic carbon contents from the week immediately preceding and the week immediately following the missing data incident. If no quality-assured data on inorganic carbon contents are available prior to the missing data incident, the substitute data value shall be the first quality-assured value for carbon contents obtained after the missing data period.



- (b) For each missing value of either the monthly soda ash production or the trona consumption, the substitute data value shall be the best available estimate(s) of the parameter(s), based on all available process data or data used for accounting purposes.
- (c) For each missing value collected during the performance test (hourly CO<sub>2</sub> concentration, stack gas volumetric flow rate, or average process vent flow from mine water stripper/evaporator during performance test), you must repeat the annual performance test following the calculation and monitoring and QA/QC requirements under §§ 98.293(b)(3) and 98.294(c).
- (d) For each missing value of the monthly process vent flow rate from mine water stripper/evaporator, the substitute data value shall be the best available estimate(s) of the parameter(s), based on all available process data or the lesser of the maximum capacity of the system or the maximum rate the meter can measure.

### § 98.296 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) or (b) of this section, as appropriate for each soda ash manufacturing facility.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required under § 98.36 and the following information in this paragraph (a):
  - (1) Annual consumption of trona or liquid alkaline feedstock for each manufacturing line (tons).
  - (2) Annual production of soda ash for each manufacturing line (tons).
  - (3) Annual production capacity of soda ash for each manufacturing line (tons).
  - (4) Identification number of each manufacturing line.
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must report the information listed in this paragraph (b):
  - (1) Identification number of each manufacturing line.
  - (2) Annual process CO<sub>2</sub> emissions from each soda ash manufacturing line (metric tons).
  - (3) Annual production of soda ash for each manufacturing line (tons).
  - (4) Annual production capacity of soda ash for each manufacturing line (tons).
  - (5)-(7) [Reserved]
  - (8) Whether CO<sub>2</sub> emissions for each manufacturing line were calculated using a trona input method as described in Equation CC-1 of this subpart, a soda ash output method as described in Equation CC-2 of this subpart, or a site-specific emission factor method as described in Equations CC-3 through CC-5 of this subpart.
  - (9) Number of manufacturing lines located used to produce soda ash.
  - (10) If you produce soda ash using the liquid alkaline feedstock process and use the site-specific emission factor method (§ 98.293(b)(3)) to estimate emissions then you must report the following relevant information for each manufacturing line or stack:
    - (i) Stack gas volumetric flow rate during performance test (dscfm).
    - (ii) Hourly CO<sub>2</sub> concentration during performance test (percent CO<sub>2</sub>).

- (iii) CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub>/metric tons of process vent flow from mine water stripper/evaporator).
- (iv) CO<sub>2</sub> mass emission rate during performance test (metric tons/hour).
- (v) Average process vent flow from mine water stripper/evaporator during performance test (pounds/hour).
- (vi) Annual process vent flow rate from mine water stripper/evaporator (thousand pounds/hour).
- (11) Number of times missing data procedures were used and for which parameter as specified in this paragraph (b)(11):
  - (i) Trona or soda ash (number of months).
  - (ii) Inorganic carbon contents of trona or soda ash (weeks).
  - (iii) Process vent flow rate from mine water stripper/evaporator (number of months).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66469, Oct. 28, 2010; 79 FR 63798, Oct. 24, 2014]

### § 98.297 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (c) of this section for each soda ash manufacturing line.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must retain under this subpart the records required for the Tier 4 Calculation Methodology specified in subpart C of this part and the information listed in this paragraph (a):
  - (1) Monthly production of soda ash (tons)
  - (2) Monthly consumption of trona or liquid alkaline feedstock (tons)
  - (3) Annual operating hours (hours).
- (b) If a CEMS is not used to measure emissions, then you must retain records for the information listed in this paragraph (b):
  - (1) Records of all analyses and calculations conducted for determining all reported data as listed in § 98.296(b).
  - (2) If using Equation CC-1 or CC-2 of this subpart, weekly inorganic carbon content factor of trona or soda ash, depending on method chosen, as measured by the applicable method in § 98.294(b) (percent by weight expressed as a decimal fraction).
  - (3) Annual operating hours for each manufacturing line used to produce soda ash (hours).
  - (4) You must document the procedures used to ensure the accuracy of the monthly trona consumption or soda ash production measurements including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
  - (5) If you produce soda ash using the liquid alkaline feedstock process and use the site-specific emission factor method to estimate emissions (§ 98.293(b)(3)) then you must also retain the following relevant information:

- (i) Records of performance test results.
- (ii) You must document the procedures used to ensure the accuracy of the annual average vent flow measurements including, but not limited to, calibration of flow rate meters and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) through (4) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) through (4) of this section
  - (1) Inorganic carbon content in trona input, from the carbon analysis results for month (percent by weight, expressed as a decimal fraction) (Equation CC-1 of § 98.293).
  - (2) Mass of trona input in month (tons) (Equation CC-1).
  - (3) Inorganic carbon content in soda ash output, from the carbon analysis results for month (percent by weight, expressed as a decimal fraction) (Equation CC-2 of § 98.293).
  - (4) Mass of soda ash output in month (tons) (Equation CC-2).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63798, Oct. 24, 2014]

## § 98.298 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart DD—Electrical Transmission and Distribution Equipment Use

**Source:** 75 FR 74855, Dec. 1, 2010, as amended at 89 FR 31933, Apr. 25, 2024, unless otherwise noted.

### § 98.300 Definition of the source category.

- (a) The electrical transmission and distribution equipment use source category consists of all electric transmission and distribution equipment and servicing inventory insulated with or containing fluorinated GHGs, including but not limited to sulfur hexafluoride (SF<sub>6</sub>) and perfluorocarbons (PFCs), used within an electric power system. Electric transmission and distribution equipment and servicing inventory includes, but is not limited to:
  - (1) Gas-insulated substations.
  - (2) Circuit breakers.
  - (3) Switchgear, including closed-pressure and hermetically sealed-pressure switchgear and gas-insulated lines containing fluorinated GHGs, including but not limited to SF<sub>6</sub> and PFCs.
  - (4) Gas containers such as pressurized cylinders.
  - (5) Gas carts.
  - (6) Electric power transformers.

(7) Other containers of fluorinated GHG, including but not limited to SF<sub>6</sub> and PFCs.

(b) [Reserved]

### § 98.301 Reporting threshold.

(a) You must report GHG emissions under this subpart if you are an electric power system as defined in § 98.308 and your facility meets the requirements of § 98.2(a)(1). To calculate total annual GHG emissions for comparison to the 25,000 metric ton CO<sub>2</sub>e per year emission threshold in table A-3 to subpart A to this part, you must calculate emissions of each fluorinated GHG that is a component of a reportable insulating gas and then sum the emissions of each fluorinated GHG resulting from the use of electrical transmission and distribution equipment for threshold applicability purposes using equation DD-1 to this section.

$$E = \sum_j \sum_i NC_{EPS,j} * GHG_{i,w} * GWP_i * EF * 0.000453592 \quad (\text{Eq. DD-1})$$

Where:

E = Annual emissions for threshold applicability purposes (metric tons CO<sub>2</sub>e).

NC<sub>EPS,j</sub> = the total nameplate capacity of equipment containing reportable insulating gas j (excluding hermetically sealed-pressure equipment) located within the facility plus the total nameplate capacity of equipment containing reportable insulating gas j (excluding hermetically sealed-pressure equipment) that is not located within the facility but is under common ownership or control (lbs).

GHG<sub>i,w</sub> = The weight fraction of fluorinated GHG i in reportable insulating gas j in the gas insulated equipment included in the total nameplate capacity NC<sub>EPS,j</sub>, expressed as a decimal fraction. If fluorinated GHG i is not part of a gas mixture, use a value of 1.0.

GWP<sub>i</sub> = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

EF = Emission factor for electrical transmission and distribution equipment (lbs emitted/lbs nameplate capacity). For all gases, use an emission factor of 0.1.

i = Fluorinated GHG contained in the electrical transmission and distribution equipment.

0.000453592 = Conversion factor from lbs to metric tons.

(b) A facility other than an electric power system that is subject to this part because of emissions from any other source category listed in table A-3 or A-4 to subpart A of this part is not required to report emissions under subpart DD of this part unless the total estimated emissions of fluorinated GHGs that are components of reportable insulating gases, as calculated in equation DD-2 to this section, equals or exceeds 25,000 tons CO<sub>2</sub>e.

$$E = \sum_j \sum_i NC_{other,j} * GHG_{i,w} * GWP_i * EF * 0.000453592 \quad (\text{Eq. DD-2})$$

Where:

E = Annual emissions for threshold applicability purposes (metric tons CO<sub>2</sub>e).

$NC_{other,j}$  = For a facility other than an electric power system, the total nameplate capacity of equipment containing reportable insulating gas  $j$  (excluding hermetically sealed-pressure equipment) located within the facility (lbs).

$GHG_{i,w}$  = The weight fraction of fluorinated GHG  $i$  in reportable insulating gas  $j$  in the gas insulated equipment included in the total nameplate capacity  $NC_{other,j}$ , expressed as a decimal fraction. If fluorinated GHG  $i$  is not part of a gas mixture, use a value of 1.0.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

EF = Emission factor for electrical transmission and distribution equipment (lbs emitted/lbs nameplate capacity). For all gases, use an emission factor of 0.1.

$i$  = Fluorinated GHG contained in the electrical transmission and distribution equipment.

0.000453592 = Conversion factor from lbs to metric tons.

### § 98.302 GHGs to report.

You must report emissions of each fluorinated GHG, including but not limited to  $SF_6$  and PFCs, from your facility (including emissions from fugitive equipment leaks, installation, servicing, equipment decommissioning and disposal, and from storage cylinders) resulting from the transmission and distribution servicing inventory and equipment listed in § 98.300(a), except you are not required to report emissions of fluorinated GHGs that are components of insulating gases whose weighted average GWPs, as calculated in equation DD-3 to this section, are less than or equal to one. For acquisitions of equipment containing or insulated with fluorinated GHGs, you must report emissions from the equipment after the title to the equipment is transferred to the electric power transmission or distribution entity.

$$GWP_j = \sum_i GHG_{i,w} * GWP_i \quad (\text{Eq. DD-3})$$

Where:

$GWP_j$  = Weighted average GWP of insulating gas  $j$ .

$GHG_{i,w}$  = The weight fraction of GHG  $i$  in insulating gas  $j$ , expressed as a decimal. fraction. If GHG  $i$  is not part of a gas mixture, use a value of 1.0.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

$i$  = GHG contained in the electrical transmission and distribution equipment.

### § 98.303 Calculating GHG emissions.

- (a) **Calculating GHG emissions.** Calculate the annual emissions of each fluorinated GHG that is a component of any reportable insulating gas using the mass-balance approach in equation DD-4 to this section:

$$\begin{aligned} \text{User Emissions}_i = & \sum_j \text{GHG}_{i,w} * [(\text{Decrease in Inventory of Reportable Insulating Gas } j) + \\ & (\text{Acquisitions of Reportable Insulating Gas } j) - (\text{Disbursements of Reportable Insulating Gas } j) - \\ & (\text{Net Increase in Total Nameplate Capacity of Equipment Operated Containing Reportable} \\ & \text{Insulating Gas } j)] \end{aligned} \quad (\text{Eq. DD-4})$$

Where:

User Emissions<sub>i</sub> = Emissions of fluorinated GHG i from the facility (pounds).

GHG<sub>i,w</sub> = The weight fraction of fluorinated GHG i in reportable insulating gas j if reportable insulating gas j is a gas mixture, expressed as a decimal fraction. If fluorinated GHG i is not part of a gas mixture, use a value of 1.0.

Decrease in Inventory of Reportable Insulating Gas j = (Pounds of reportable insulating gas j stored in containers, but not in energized equipment, at the beginning of the year) – (Pounds of reportable insulating gas j stored in containers, but not in energized equipment, at the end of the year). Reportable insulating gas inside equipment that is not energized is considered to be “stored in containers.”

Acquisitions of Reportable Insulating gas j = (Pounds of reportable insulating gas j purchased or otherwise acquired from chemical producers, chemical distributors, or other entities in bulk) + (Pounds of reportable insulating gas j purchased or otherwise acquired from equipment manufacturers, equipment distributors, or other entities with or inside equipment, including hermetically sealed-pressure switchgear, while the equipment was not in use) + (Pounds of each SF<sub>6</sub> insulating gas j returned to facility after off-site recycling) + (Pounds of reportable insulating gas j acquired inside equipment, except hermetically sealed-pressure switchgear, that was transferred while the equipment was in use, e.g., through acquisition of all or part of another electric power system).

Disbursements of Reportable Insulating gas j = (Pounds of reportable insulating gas j returned to suppliers) + (Pounds of reportable insulating gas j sent off site for recycling) + (Pounds of reportable insulating gas j sent off-site for destruction) + (Pounds of reportable insulating gas j that was sold or transferred to other entities in bulk) + (Pounds of reportable insulating gas j contained in equipment, including hermetically sealed-pressure switchgear, that was sold or transferred to other entities while the equipment was not in use) + (Pounds of reportable insulating gas j inside equipment, except hermetically sealed-pressure switchgear, that was transferred while the equipment was in use, e.g., through sale of all or part of the electric power system to another electric power system).

Net Increase in Total Nameplate Capacity of Equipment Operated containing reportable insulating gas j = (The Nameplate Capacity of new equipment, as defined at § 98.308, containing reportable insulating gas j in pounds) – (Nameplate Capacity of retiring equipment, as defined at § 98.308, containing reportable insulating gas j in pounds). (Note that Nameplate Capacity refers to the full and proper charge of equipment rather than to the actual charge, which may reflect leakage).

- (b) **Nameplate capacity adjustments.** Users of closed-pressure electrical equipment with a voltage capacity greater than 38 kV may measure and adjust the nameplate capacity value specified by the equipment manufacturer on the nameplate attached to that equipment, or within the equipment manufacturer's

official product specifications, by following the requirements in paragraphs (b)(1) through (10) of this section. Users of other electrical equipment are not permitted to adjust the nameplate capacity value of the other equipment.

- (1) If you elect to measure the nameplate capacity value(s) of one or more pieces of electrical equipment with a voltage capacity greater than 38 kV, you must measure the nameplate capacity values of all the electrical equipment in your facility that has a voltage capacity greater than 38 kV and that is installed or retired in that reporting year and in subsequent reporting years.
- (2) You must adopt the measured nameplate capacity value for any piece of equipment for which the absolute value of the difference between the measured nameplate capacity value and the nameplate capacity value most recently specified by the manufacturer equals or exceeds two percent of the nameplate capacity value most recently specified by the manufacturer.
- (3) You may adopt the measured nameplate capacity value for equipment for which the absolute value of the difference between the measured nameplate capacity value and the nameplate capacity value most recently specified by the manufacturer is less than two percent of the nameplate capacity value most recently specified by the manufacturer, but if you elect to adopt the measured nameplate capacity for that equipment, then you must adopt the measured nameplate capacity value for all of the equipment for which the difference between the measured nameplate capacity value and the nameplate capacity value most recently specified by the manufacturer is less than two percent of the nameplate capacity value most recently specified by the manufacturer. This applies in the reporting year in which you first adopt the measured nameplate capacity for the equipment and in subsequent reporting years.
- (4) Users of electrical equipment measuring the nameplate capacity of any new electrical equipment must:
  - (i) Record the amount of insulating gas in the equipment at the time the equipment was acquired (pounds), either per information provided by the manufacturer, or by transferring insulating gas from the equipment to a gas container and measuring the amount of insulating gas transferred. The equipment user is responsible for ensuring the gas is accounted for consistent with the methodologies specified in paragraphs (b)(4)(ii) through (iii) and (b)(5) of this section. If no insulating gas was in the device when it was acquired, record this value as zero.
  - (ii) If insulating gas is added to the equipment subsequent to the acquisition of the equipment to energize it the first time, transfer the insulating gas to the equipment to reach the temperature-compensated design operating pressure per manufacturer specifications. Follow the manufacturer-specified procedure to ensure that the measured temperature accurately reflects the temperature of the insulating gas, e.g., by measuring the insulating gas pressure and vessel temperature after allowing appropriate time for the temperature of the transferred gas to equilibrate with the vessel temperature. Measure and calculate the total amount of reportable insulating gas added to the device using one of the methods specified in paragraphs (b)(4)(ii)(A) and (B) of this section.
    - (A) To determine the amount of reportable insulating gas transferred to the electrical equipment, weigh the gas container being used to fill the device prior to, and after, the addition of the reportable insulating gas to the electrical equipment, and subtract the second value (after-transfer gas container weight) from the first value (prior-to-transfer gas container weight). Account for any gas contained in hoses before and after the transfer.

- (B) Connect a mass flow meter between the electrical equipment and a gas cart. Transfer gas to the equipment to reach the temperature-compensated design operating pressure per manufacturer specifications. During gas transfer, you must keep the mass flow rate within the range specified by the mass flow meter manufacturer to assure an accurate and precise mass flow meter reading. Close the connection to the GIE from the mass flow meter hose and ensure that the gas trapped in the filling hose returns through the mass flow meter. Calculate the amount of gas transferred from the mass reading on the mass flow meter.
  - (iii) Sum the results of paragraphs (b)(4)(i) and (ii) to obtain the measured nameplate capacity for the new equipment.
- (5) Electrical equipment users measuring the nameplate capacity of any retiring electrical equipment must:
- (i) Measure and record the initial system pressure and vessel temperature prior to removing any insulating gas.
  - (ii) Compare the initial system pressure and temperature to the equipment manufacturer's temperature/pressure curve for that equipment and insulating gas.
  - (iii) If the temperature-compensated initial system pressure of the electrical equipment does not match the temperature-compensated design operating pressure specified by the equipment manufacturer, you may either:
    - (A) Add or remove insulating gas to/from the electrical equipment until the manufacturer-specified value is reached, or
    - (B) If the temperature-compensated initial system pressure of the electrical equipment is no higher than the temperature-compensated design operating pressure specified by the manufacturer and no lower than five pounds per square inch (5 psi) less than the temperature-compensated design operating pressure specified by the manufacturer, use equation DD-5 to this section to calculate the nameplate capacity based on the mass recorded under paragraph (b)(5)(vi) of this section.
  - (iv) Weigh the gas container being used to receive the gas and record this value.
  - (v) Recover insulating gas from the electrical equipment until five minutes after the pressure in the electrical equipment reaches a pressure of at most five pounds per square inch absolute (5 psia).
  - (vi) Record the amount of insulating gas recovered (pounds) by weighing the gas container that received the gas and subtracting the weight recorded pursuant to paragraph (b)(5)(iv)(B) of this section from this value. Account for any gas contained in hoses before and after the transfer. The amount of gas recovered shall be the measured nameplate capacity for the electrical equipment unless the final temperature-compensated pressure of the electrical equipment exceeds 0.068 psia (3.5 Torr) or the electrical equipment user is calculating the nameplate capacity pursuant to paragraph (b)(5)(iii)(B) of this section, in which cases the measured nameplate capacity shall be the result of equation DD-5 to this section.
  - (vii) If you are calculating the nameplate capacity pursuant to paragraph (b)(5)(iii)(B) of this section, use equation DD-5 to this section to do so.



$$NC_C = \frac{P_{NC}}{(P_i - P_f)} \times M_R \quad (\text{Eq. DD-5})$$

Where:

$NC_C$  = Nameplate capacity of the equipment measured and calculated by the equipment user (pounds).

$P_i$  = Initial temperature-compensated pressure of the equipment, based on the temperature-pressure curve for the insulating gas (psia).

$P_f$  = Final temperature-compensated pressure of the equipment, based on the temperature-pressure curve for the insulating gas (psia). This may be equated to zero if the final temperature-compensated pressure of the equipment is equal to or lower than 0.068 psia (3.5 Torr).

$P_{NC}$  = Temperature-compensated pressure of the equipment at the manufacturer-specified filling density of the equipment (*i.e.*, at the full and proper charge, psia).

$M_R$  = Mass of insulating gas recovered from the equipment, measured in paragraph (b)(5)(vi) of this section (pounds).

(viii) Record the final system pressure and vessel temperature.

- (6) Instead of measuring the nameplate capacity of electrical equipment when it is retired, users may measure the nameplate capacity of electrical equipment during maintenance activities that require opening the gas compartment, but they must follow the procedures set forth in paragraph (b)(5) of this section.
- (7) If the electrical equipment will remain energized, and the electrical equipment user is adopting the user-measured nameplate capacity, the electrical equipment user must affix a revised nameplate capacity label, showing the revised nameplate value and the year the nameplate capacity adjustment process was performed, to the device by the end of the calendar year in which the process was completed. The manufacturer's previous nameplate capacity label must remain visible after the revised nameplate capacity label is affixed to the device.
- (8) For each piece of electrical equipment whose nameplate capacity was adjusted during the reporting year, the revised nameplate capacity value must be used in all provisions wherein the nameplate capacity is required to be recorded, reported, or used in a calculation in this subpart unless otherwise specified herein.
- (9) The nameplate capacity of a piece of electrical equipment may only be adjusted more than once if the physical capacity of the device has changed (*e.g.*, replacement of bushings) after the initial adjustment was performed, in which case the equipment user must adjust the nameplate capacity pursuant to the provisions of this paragraph (b).
- (10) Measuring devices used to measure the nameplate capacity of electrical equipment under this paragraph (b) must meet the following accuracy and precision requirements:
  - (i) Flow meters must be certified by the manufacturer to be accurate and precise to within one percent of the largest value that the flow meter can, according to the manufacturer's specifications, accurately record.

- (ii) Pressure gauges must be certified by the manufacturer to be accurate and precise to within 0.5% of the largest value that the gauge can, according to the manufacturer's specifications, accurately record.
- (iii) Temperature gauges must be certified by the manufacturer to be accurate and precise to within  $\pm 1.0$  °F.
- (iv) Scales must be certified by the manufacturer to be accurate and precise to within one percent of the true weight.

#### § 98.304 Monitoring and QA/QC requirements.

- (a) [Reserved]
- (b) You must adhere to the following QA/QC methods for reviewing the completeness and accuracy of reporting:
  - (1) Review inputs to equation DD-4 to § 98.303 to ensure inputs and outputs to the company's system are included.
  - (2) Do not enter negative inputs and confirm that negative emissions are not calculated. However, the Decrease in fluorinated GHG Inventory and the Net Increase in Total Nameplate Capacity may be calculated as negative numbers.
  - (3) Ensure that beginning-of-year inventory matches end-of-year inventory from the previous year.
  - (4) Ensure that in addition to fluorinated GHG purchased from bulk gas distributors, fluorinated GHG purchased from Original Equipment Manufacturers (OEM) and fluorinated GHG returned to the facility from off-site recycling are also accounted for among the total additions.
- (c) Ensure the following QA/QC methods are employed throughout the year:
  - (1) Ensure that cylinders returned to the gas supplier are consistently weighed on a scale that is certified to be accurate and precise to within 2 pounds of true weight and is periodically recalibrated per the manufacturer's specifications. Either measure residual gas (the amount of gas remaining in returned cylinders) or have the gas supplier measure it. If the gas supplier weighs the residual gas, obtain from the gas supplier a detailed monthly accounting, within  $\pm 2$  pounds, of residual gas amounts in the cylinders returned to the gas supplier.
  - (2) Ensure that cylinders weighed for the beginning and end of year inventory measurements are weighed on a scale that is certified to be accurate and precise to within 2 pounds of true weight and is periodically recalibrated per the manufacturer's specifications. All scales used to measure quantities that are to be reported under § 98.306 must be calibrated using calibration procedures specified by the scale manufacturer. Calibration must be performed prior to the first reporting year. After the initial calibration, recalibration must be performed at the minimum frequency specified by the manufacturer.
  - (3) Ensure all substations have provided information to the manager compiling the emissions report (if it is not already handled through an electronic inventory system).
- (d) GHG Monitoring Plans, as described in § 98.3(g)(5), must be completed by April 1, 2011.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71966, Nov. 29, 2013]

### § 98.305 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Replace missing data, if needed, based on data from equipment with a similar nameplate capacity for fluorinated GHGs, and from similar equipment repair, replacement, and maintenance operations.

### § 98.306 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information for each electric power system, by chemical:

- (a) Nameplate capacity of equipment (pounds) containing each insulating gas:
  - (1) Existing at the beginning of the year (excluding hermetically sealed-pressure switchgear).
  - (2) New hermetically sealed-pressure switchgear during the year.
  - (3) New equipment other than hermetically sealed-pressure switchgear during the year.
  - (4) Retired hermetically sealed-pressure switchgear during the year.
  - (5) Retired equipment other than hermetically sealed-pressure switchgear during the year.
- (b) Transmission miles (length of lines carrying voltages above 35 kilovolts).
- (c) Distribution miles (length of lines carrying voltages at or below 35 kilovolts).
- (d) Pounds of each reportable insulating gas stored in containers, but not in energized equipment, at the beginning of the year.
- (e) Pounds of each reportable insulating gas stored in containers, but not in energized equipment, at the end of the year.
- (f) Pounds of each reportable insulating gas purchased or otherwise acquired in bulk from chemical producers, chemical distributors, or other entities.
- (g) Pounds of each reportable insulating gas purchased or otherwise acquired from equipment manufacturers, equipment distributors, or other entities with or inside equipment, including hermetically sealed-pressure switchgear, while the equipment was not in use.
- (h) Pounds of each reportable insulating gas returned to facility after off-site recycling.
- (i) Pounds of each reportable insulating gas acquired inside equipment, except hermetically sealed-pressure switchgear, that was transferred while the equipment was in use, e.g., through acquisition of all or part of another electric power system.
- (j) Pounds of each reportable insulating gas returned to suppliers.
- (k) Pounds of each reportable insulating gas that was sold or transferred to other entities in bulk.
- (l) Pounds of each reportable insulating gas sent off-site for recycling.
- (m) Pounds of each reportable insulating gas sent off-site for destruction.
- (n) Pounds of each reportable insulating gas contained in equipment, including hermetically sealed-pressure switchgear, that was sold or transferred to other entities while the equipment was not in use.

- (o) Pounds of each reportable insulating gas disbursed inside equipment, except hermetically sealed-pressure switchgear, that was transferred while the equipment was in use, e.g., through sale of all or part of the electric power system to another electric power system.
- (p) State(s) or territory in which the facility lies.
- (q) The number of reportable-insulating-gas-containing pieces of equipment in each of the following equipment categories:
  - (1) New hermetically sealed-pressure switchgear during the year.
  - (2) New equipment other than hermetically sealed-pressure switchgear during the year.
  - (3) Retired hermetically sealed-pressure switchgear during the year.
  - (4) Retired equipment other than hermetically sealed-pressure switchgear during the year.
- (r) The total of the nameplate capacity values most recently assigned by the electrical equipment manufacturer(s) to each of the following groups of equipment:
  - (1) All new equipment whose nameplate capacity values were measured by the user under this subpart and for which the user adopted the user-measured nameplate capacity value during the year.
  - (2) All retiring equipment whose nameplate capacity values were measured by the user under this subpart and for which the user adopted the user-measured nameplate capacity value during the year.
- (s) The total of the nameplate capacity values measured by the electrical equipment user for each of the following groups of equipment:
  - (1) All new equipment whose nameplate capacity values were measured by the user under this subpart and for which the user adopted the user-measured nameplate capacity value during the year.
  - (2) All retiring equipment whose nameplate capacity values were measured by the user under this subpart and for which the user adopted the user-measured nameplate capacity value during the year.
- (t) For each reportable insulating gas reported in paragraphs (a), (d) through (o), and (q) of this section, an ID number or other appropriate descriptor that is unique to that reportable insulating gas.
- (u) For each ID number or descriptor reported in paragraph (t) of this section for each unique insulating gas, the name (as required in § 98.3(c)(4)(iii)(G)(1)) and weight percent of each fluorinated gas in the insulating gas.

[74 FR 56374, Oct. 30, 2009, as amended at 81 FR 89264, Dec. 9, 2016]

### § 98.307 Records that must be retained.

- (a) In addition to the information required by § 98.3(g), you must retain records of the information reported and listed in § 98.306.
- (b) For each piece of electrical equipment whose nameplate capacity is measured by the equipment user, retain records of the following:
  - (1) Equipment manufacturer name.

- (2) Year equipment was manufactured. If the date year the equipment was manufactured cannot be determined, report a best estimate of the year of manufacture and record how the estimated year was determined.
- (3) Manufacturer serial number. For any piece of equipment whose serial number is unknown (e.g., the serial number does not exist or is not visible), another unique identifier must be recorded as the manufacturer serial number. The electrical equipment user must retain documentation that allows for each electrical equipment to be readily identifiable.
- (4) Equipment type (i.e., closed-pressure vs. hermetically sealed-pressure).
- (5) Equipment voltage capacity (in kilovolts).
- (6) The name and GWP of each insulating gas used.
- (7) Nameplate capacity value (pounds), as specified by the equipment manufacturer. The value must reflect the latest value specified by the manufacturer during the reporting year.
- (8) Nameplate capacity value (pounds) measured by the equipment user.
- (9) The date the nameplate capacity measurement process was completed.
- (10) The measurements and calculations used to calculate the value in paragraph (b)(8) of this section.
- (11) The temperature-pressure curve and/or other information used to derive the initial and final temperature-adjusted pressures of the equipment.
- (12) Whether or not the nameplate capacity value in paragraph (b)(8) of this section has been adopted for the piece of electrical equipment.

## § 98.308 Definitions.

Except as specified in this section, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Facility**, with respect to an electric power system, means the electric power system as set out in this definition.

An electric power system is comprised of all electric transmission and distribution equipment insulated with or containing fluorinated GHGs that is linked through electric power transmission or distribution lines and functions as an integrated unit, that is owned, serviced, or maintained by a single electric power transmission or distribution entity (or multiple entities with a common owner), and that is located between:

- (1) The point(s) at which electric energy is obtained from an electricity generating unit or a different electric power transmission or distribution entity that does not have a common owner; and
- (2) The point(s) at which any customer or another electric power transmission or distribution entity that does not have a common owner receives the electric energy. The facility also includes servicing inventory for such equipment that contains fluorinated GHGs.

**Electric power transmission or distribution entity** means any entity that transmits, distributes, or supplies electricity to a consumer or other user, including any company, electric cooperative, public electric supply corporation, a similar Federal department (including the Bureau of Reclamation or the Corps of Engineers), a municipally owned electric department offering service to the public, an electric public utility district, or a jointly owned electric supply project.

**Energized**, for the purposes of this subpart, means connected through busbars or cables to an electrical power system or fully-charged, ready for service, and being prepared for connection to the electrical power system. Energized equipment does not include spare gas insulated equipment (including hermetically-sealed pressure switchgear) in storage that has been acquired by the facility, and is intended for use by the facility, but that is not being used or prepared for connection to the electrical power system.

**Insulating gas**, for the purposes of this subpart, means any fluorinated GHG or fluorinated GHG mixture, including but not limited to SF<sub>6</sub> and PFCs, that is used as an insulating and/or arc-quenching gas in electrical equipment.

**New equipment**, for the purposes of this subpart, means either any gas insulated equipment, including hermetically-sealed pressure switchgear, that is not energized at the beginning of the reporting year but is energized at the end of the reporting year, or any gas insulated equipment other than hermetically-sealed pressure switchgear that has been transferred while in use, meaning it has been added to the facility's inventory without being taken out of active service (e.g., when the equipment is sold to or acquired by the facility while remaining in place and continuing operation).

**Operator**, for the purposes of this subpart, means any person who operates or supervises a facility, excluding a person whose sole responsibility is to ensure reliability, balance load or otherwise address electricity flow.

**Reportable insulating gas**, for purposes of this subpart, means an insulating gas whose weighted average GWP, as calculated in equation DD-3 to § 98.302, is greater than one. A fluorinated GHG that makes up either part or all of a reportable insulating gas is considered to be a component of the reportable insulating gas.

**Retired equipment**, for the purposes of this subpart, means either any gas insulated equipment including hermetically-sealed pressure switchgear, that is energized at the beginning of the reporting year but is not energized at the end of the reporting year, or any gas insulated equipment other than hermetically-sealed pressure switchgear that has been transferred while in use, meaning it has been removed from the facility's inventory without being taken out of active service (e.g., when the equipment is acquired by a new facility while remaining in place and continuing operation).

## Subpart EE—Titanium Dioxide Production

### § 98.310 Definition of the source category.

The titanium dioxide production source category consists of facilities that use the chloride process to produce titanium dioxide.

### § 98.311 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a titanium dioxide production process and the facility meets the requirements of either § 98.2(a)(1) or (a)(2).

### § 98.312 GHGs to report.

- (a) You must report CO<sub>2</sub> process emissions from each chloride process line as required in this subpart.
- (b) You must report CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

## § 98.313 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions for each chloride process line using the procedures in either paragraph (a) or (b) of this section.

- (a) Calculate and report under this subpart the process CO<sub>2</sub> emissions by operating and maintaining a CEMS according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart the annual process CO<sub>2</sub> emissions for each chloride process line by determining the mass of calcined petroleum coke consumed in each line as specified in paragraphs (b)(1) through (b)(3) of this section. Use Equation EE-1 of this section to calculate annual combined process CO<sub>2</sub> emissions from all process lines and use Equation EE-2 of this section to calculate annual process CO<sub>2</sub> emissions for each process line. If your facility generates carbon-containing waste, use Equation EE-3 of this section to estimate the annual quantity of carbon-containing waste generated and its carbon contents according to § 98.314(e) and (f):
  - (1) You must calculate the annual CO<sub>2</sub> process emissions from all process lines at the facility using Equation EE-1 of this section:

$$CO_2 = \sum_{p=1}^m E_p \quad (\text{Eq. EE-1})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions from titanium dioxide production facility (metric tons/year).

E<sub>p</sub> = Annual CO<sub>2</sub> emissions from chloride process line p (metric tons), determined using Equation EE-2 of this section.

p = Process line.

m = Number of separate chloride process lines located at the facility.

- (2) You must calculate the annual CO<sub>2</sub> process emissions from each process lines at the facility using Equation EE-2 of this section:

$$E_p = \sum_{n=1}^{12} \frac{44}{12} \cdot C_{p,n} \cdot \frac{2000}{2205} \cdot CCF_n \quad (\text{Eq. EE-2})$$

Where:

E<sub>p</sub> = Annual CO<sub>2</sub> mass emissions from chloride process line p (metric tons).

C<sub>p,n</sub> = Calcined petroleum coke consumption for process line p in month n (tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

2000/2205 = Conversion of tons to metric tons.

$CCF_n$  = Carbon content factor for petroleum coke consumed in month  $n$  from the supplier or as measured by the applicable method incorporated by reference in § 98.7 according to § 98.314(c) (percent by weight expressed as a decimal fraction).

$n$  = Number of month.

- (3) If facility generates carbon-containing waste, you must calculate the total annual quantity of carbon-containing waste produced from all process lines using Equation EE-3 of this section and its carbon contents according to § 98.314(e) and (f):

$$TWC = \sum_{p=1}^m \sum_{n=1}^{12} WC_{p,n} \quad (\text{Eq. EE-3})$$

Where:

TWC = Annual production of carbon-containing waste from titanium dioxide production facility (tons).

$WC_{p,n}$  = Production of carbon-containing waste in month  $n$  from chloride process line  $p$  (tons).

$p$  = Process line.

$m$  = Total number of process lines.

$n$  = Number of month.

- (c) If GHG emissions from a chloride process line are vented through the same stack as any combustion unit or process equipment that reports  $CO_2$  emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate process  $CO_2$  emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.

### § 98.314 Monitoring and QA/QC requirements.

- (a) You must measure your consumption of calcined petroleum coke using plant instruments used for accounting purposes including direct measurement weighing the petroleum coke fed into your process (by belt scales or a similar device) or through the use of purchase records.
- (b) You must document the procedures used to ensure the accuracy of monthly calcined petroleum coke consumption measurements.
- (c) You must determine the carbon content of the calcined petroleum coke each month based on reports from the supplier. Alternatively, facilities can measure monthly carbon contents of the petroleum coke using ASTM D3176-89 (Reapproved 2002) Standard Practice for Ultimate Analysis of Coal and Coke



(incorporated by reference, see § 98.7) and ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7).

- (d) For quality assurance and quality control of the supplier data, you must conduct an annual measurement of the carbon content from a representative sample of the petroleum coke consumed using ASTM D3176-89 and ASTM D5373-08.
- (e) You must determine the quantity of carbon-containing waste generated from each titanium dioxide production line on a monthly basis using plant instruments used for accounting purposes including direct measurement weighing the carbon-containing waste not used during the process (by belt scales or a similar device) or through the use of sales records.
- (f) You must determine the carbon contents of the carbon-containing waste from each titanium production line on an annual basis by collecting and analyzing a representative sample of the material using ASTM D3176-89 and ASTM D5373-08.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66469, Oct. 28, 2010]

### § 98.315 Procedures for estimating missing data.

For the petroleum coke input procedure in § 98.313(b), a complete record of all measured parameters used in the GHG emissions calculations is required (e.g., carbon content values, etc.). Therefore, whenever the monitoring and quality assurance procedures in § 98.315 cannot be followed, a substitute data value for the missing parameter shall be used in the calculations as specified in the paragraphs (a) through (c) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) For each missing value of the monthly carbon content of calcined petroleum coke the substitute data value shall be the arithmetic average of the quality-assured values of carbon contents for the month immediately preceding and the month immediately following the missing data incident. If no quality-assured data on carbon contents are available prior to the missing data incident, the substitute data value shall be the first quality-assured value for carbon contents obtained after the missing data period.
- (b) For each missing value of the monthly calcined petroleum coke consumption and/or carbon-containing waste, the substitute data value shall be the best available estimate of the monthly petroleum coke consumption based on all available process data or information used for accounting purposes (such as purchase records).
- (c) For each missing value of the carbon content of carbon-containing waste, you must conduct a new analysis following the procedures in § 98.314(f).

### § 98.316 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) or (b) of this section, as applicable for each titanium dioxide production line.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report the relevant information required under § 98.36(e)(2)(vi) for the Tier 4 Calculation Methodology and the following information in this paragraph (a).
  - (1) Identification number of each process line.

- (2) Annual consumption of calcined petroleum coke (tons).
  - (3) Annual production of titanium dioxide (tons).
  - (4) Annual production capacity of titanium dioxide (tons).
  - (5) Annual production of carbon-containing waste (tons), if applicable.
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must report the information listed in this paragraph (b):
- (1) Identification number of each process line.
  - (2) Annual CO<sub>2</sub> emissions from each chloride process line (metric tons/year).
  - (3) Annual consumption of calcined petroleum coke for each process line (tons).
  - (4) Annual production of titanium dioxide for each process line (tons).
  - (5) Annual production capacity of titanium dioxide for each process line (tons).
  - (6) [Reserved]
  - (7) Annual production of carbon-containing waste for each process line (tons), if applicable.
  - (8) Monthly production of titanium dioxide for each process line (tons).
  - (9) [Reserved]
  - (10) Whether monthly carbon content of the petroleum coke is based on reports from the supplier or through self measurement using applicable ASTM standard methods.
  - (11) Carbon content for carbon-containing waste for each process line (percent by weight expressed as a decimal fraction).
  - (12) If carbon content of petroleum coke is based on self measurement, the ASTM standard methods used.
  - (13) Sampling analysis results of carbon content of petroleum coke as determined for QA/QC of supplier data under § 98.314(d) (percent by weight expressed as a decimal fraction).
  - (14) Number of separate chloride process lines located at the facility.
  - (15) The number of times in the reporting year that missing data procedures were followed to measure the carbon contents of petroleum coke (number of months); petroleum coke consumption (number of months); carbon-containing waste generated (number of months); and carbon contents of the carbon-containing waste (number of times during year).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66469, Oct. 28, 2010; 79 FR 63799, Oct. 24, 2014]

### § 98.317 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (c) of this section for each titanium dioxide production facility.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must retain under this subpart required for the Tier 4 Calculation Methodology in § 98.37 and the information listed in this paragraph (a):

- (1) Records of all calcined petroleum coke purchases.
- (2) Annual operating hours for each titanium dioxide process line.
- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must retain records for the information listed in this paragraph:
  - (1) Records of all calcined petroleum coke purchases (tons).
  - (2) Records of all analyses and calculations conducted for all reported data as listed in § 98.316(b).
  - (3) Sampling analysis results for carbon content of consumed calcined petroleum coke (percent by weight expressed as a decimal fraction).
  - (4) Sampling analysis results for the carbon content of carbon containing waste (percent by weight expressed as a decimal fraction), if applicable.
  - (5) Monthly production of carbon-containing waste (tons).
  - (6) You must document the procedures used to ensure the accuracy of the monthly petroleum coke consumption and quantity of carbon-containing waste measurement including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
  - (7) Annual operating hours for each titanium dioxide process line (hours).
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) and (2) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) and (2) of this section.
  - (1) Carbon content factor for petroleum coke consumed in month from the supplier or as measured by the applicable method incorporated by reference in § 98.7 according to § 98.314(c) (percent by weight, expressed as a decimal fraction) (Equation EE-2 of § 98.313).
  - (2) Calcined petroleum coke consumption for process line in month (tons) (Equation EE-2).

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63799, Oct. 24, 2014]

## § 98.318 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart FF—Underground Coal Mines

**Source:** 75 FR 39763, July 12, 2010, unless otherwise noted.

## § 98.320 Definition of the source category.

- (a) This source category consists of active underground coal mines, and any underground mines under development that have operational pre-mining degasification systems. An underground coal mine is a mine at which coal is produced by tunneling into the earth to the coalbed, which is then mined with

underground mining equipment such as cutting machines and continuous, longwall, and shortwall mining machines, and transported to the surface. Underground coal mines are categorized as active if any one of the following five conditions apply:

- (1) Mine development is underway.
- (2) Coal has been produced within the last 90 days.
- (3) Mine personnel are present in the mine workings.
- (4) Mine ventilation fans are operative.
- (5) The mine is designated as an "intermittent" mine by the Mine Safety and Health Administration (MSHA).

(b) This source category includes the following:

- (1) Each ventilation system shaft or vent hole, including both those points where mine ventilation air is emitted and those where it is sold, used onsite, or otherwise destroyed (including by ventilation air methane (VAM) oxidizers).
- (2) Each degasification system well or gob gas vent hole, including degasification systems deployed before, during, or after mining operations are conducted in a mine area. This includes both those wells and vent holes where coal bed gas is emitted, and those where the gas is sold, used onsite, or otherwise destroyed (including by flaring).

(c) This source category does not include abandoned or closed mines, surface coal mines, or post-coal mining activities (e.g., storage or transportation of coal).

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71966, Nov. 29, 2013]

## § 98.321 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an active underground coal mine and the facility meets the requirements of § 98.2(a)(1).

## § 98.322 GHGs to report.

- (a) You must report CH<sub>4</sub> liberated from ventilation and degasification systems.
- (b) You must report CH<sub>4</sub> destruction from systems where gas is sold, used onsite, or otherwise destroyed (including by VAM oxidation and by flaring).
- (c) You must report net CH<sub>4</sub> emissions from ventilation and degasification systems.
- (d) You must report under this subpart the CO<sub>2</sub> emissions from coal mine gas CH<sub>4</sub> destruction occurring at the facility, where the gas is not a fuel input for energy generation or use (e.g., flaring and VAM oxidation).
- (e) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary fuel combustion unit by following the requirements of subpart C. Report emissions from both the combustion of collected coal mine CH<sub>4</sub> and any other fuels.

- (f) An underground coal mine that is subject to this part because emissions from source categories described in Tables A-3, A-4 or A-5 of subpart A of this part, or from stationary combustion (subpart C of this part), is not required to report emissions under this subpart unless the coal mine liberates 36,500,000 actual cubic feet (acf) or more of methane per year from its ventilation system.

[75 FR 39763, July 12, 2010, as amended at 76 FR 73901, Nov. 29, 2011; 78 FR 71966, Nov. 29, 2013]

## § 98.323 Calculating GHG emissions.

- (a) For each ventilation shaft, vent hole, or centralized point into which CH<sub>4</sub> from multiple shafts and/or vent holes are collected, you must calculate the quarterly CH<sub>4</sub> liberated from the ventilation system using Equation FF-1 of this section. You must measure CH<sub>4</sub> content, flow rate, temperature, pressure, and moisture content of the gas using the procedures outlined in § 98.324.

$$CH_{4V} = n \cdot \left( V \cdot MCF \cdot \frac{C}{100\%} \cdot 0.0423 \cdot \frac{520^{\circ}R}{T} \cdot \frac{P}{1 \text{ atm}} \cdot 1,440 \cdot \frac{0.454}{1,000} \right) \quad (\text{Eq. FF-1})$$

Where:

CH<sub>4V</sub> = Quarterly CH<sub>4</sub> liberated from a ventilation monitoring point (metric tons CH<sub>4</sub>).

V = Volumetric flow rate for the quarter (acfm) based on sampling or a flow rate meter. If a flow rate meter is used and the meter automatically corrects to standard temperature and pressure, then use scfm and replace "520°R/T × P/1 atm" with "1".

MCF = Moisture correction factor for the measurement period, volumetric basis.

= 1 when V and C are measured on a dry basis or if both are measured on a wet basis.

= 1-(f<sub>H2O</sub>) when V is measured on a wet basis and C is measured on a dry basis.

= 1/[1-(f<sub>H2O</sub>)] when V is measured on a dry basis and C is measured on a wet basis.

(f<sub>H2O</sub>) = Moisture content of the CH<sub>4</sub> emitted during the measurement period, volumetric basis (cubic feet water per cubic feet emitted gas).

C = CH<sub>4</sub> concentration of ventilation gas for the quarter (%).

n = The number of days in the quarter where active ventilation of mining operations is taking place at the monitoring point. To obtain the number of days in the quarter, divide the total number of hours in the quarter where active ventilation is taking place by 24 hours per day.

0.0423 = Density of CH<sub>4</sub> at 520 °R (60 °F) and 1 atm (lb/scf).

520 °R = 520 degrees Rankine.

T = Temperature at which flow is measured (°R) for the quarter.

P = Absolute pressure at which flow is measured (atm) for the quarter. The annual average barometric pressure from the nearest NOAA weather service station may be used as a default.

1,440 = Conversion factor (min/day).

0.454/1,000 = Conversion factor (metric ton/lb).

(1) The quarterly periods are:

(i) January 1-March 31.

(ii) April 1-June 30.

(iii) July 1-September 30.

(iv) October 1-December 31.

(2) Values of V, C, T, P, and, if applicable, ( $f_{H_2O}$ ), must be based on measurements taken at least once each quarter with no fewer than 6 weeks between measurements. If measurements are taken more frequently than once per quarter, then use the average value for all measurements taken. If continuous measurements are taken, then use the average value over the time period of continuous monitoring.

(3) If a facility has more than one monitoring point, the facility must calculate total  $CH_4$  liberated from ventilation systems ( $CH_{4VTotal}$ ) as the sum of the  $CH_4$  from all ventilation monitoring points in the mine, as follows:

$$CH_{4VTotal} = \sum_{i=1}^n (CH_{4V}), \quad (\text{Eq. FF-2})$$

Where:

$CH_{4VTotal}$  = Total quarterly  $CH_4$  liberated from ventilation systems (metric tons  $CH_4$ ).

$CH_{4V}$  = Quarterly  $CH_4$  liberated from each ventilation monitoring point (metric tons  $CH_4$ ).

m = Number of ventilation monitoring points.

(b) For each monitoring point in the degasification system (this could be at each degasification well and/or vent hole, or at more centralized points into which  $CH_4$  from multiple wells and/or vent holes are collected), you must calculate the weekly  $CH_4$  liberated from the mine using  $CH_4$  measured weekly or more frequently (including by CEMS) according to 98.234(c),  $CH_4$  content, flow rate, temperature, pressure, and moisture content, and Equation FF-3 of this section.

$$CH_{4D} = \sum_{i=1}^n \left( V_i * MCF_i * \frac{C_i}{100\%} * 0.0423 \frac{520^\circ R}{T_i} * \frac{P_i}{1 atm} * 1,440 * \frac{0.454}{1,000} \right) \quad (\text{Eq. FF-3})$$

Where:

$CH_{4D}$  = Weekly  $CH_4$  liberated from the monitoring point (metric tons  $CH_4$ ).

$V_i$  = Measured volumetric flow rate for the days in the week when the degasification system is in operation at that monitoring point, based on sampling or a flow rate meter (acfm). If a flow rate meter is used and the meter automatically corrects to standard temperature and pressure, then use scfm and replace " $520^\circ\text{R}/T_i \times P_i/1 \text{ atm}$ " with "1".

$\text{MCF}_i$  = Moisture correction factor for the measurement period, volumetric basis.

= 1 when  $V_i$  and  $C_i$  are measured on a dry basis or if both are measured on a wet basis.

=  $1 - (f_{\text{H}_2\text{O}})_i$  when  $V_i$  is measured on a wet basis and  $C_i$  is measured on a dry basis.

=  $1/[1 - (f_{\text{H}_2\text{O}})_i]$  when  $V_i$  is measured on a dry basis and  $C_i$  is measured on a wet basis.

$(f_{\text{H}_2\text{O}})$  = Moisture content of the  $\text{CH}_4$  emitted during the measurement period, volumetric basis (cubic feet water per cubic feet emitted gas).

$C_i$  =  $\text{CH}_4$  concentration of gas for the days in the week when the degasification system is in operation at that monitoring point (%).

$n$  = The number of days in the week that the system is operational at that measurement point. To obtain the number of days in the week, divide the total number of hours that the system is operational by 24 hours per day.

0.0423 = Density of  $\text{CH}_4$  at  $520^\circ\text{R}$  ( $60^\circ\text{F}$ ) and 1 atm (lb/scf).

$520^\circ\text{R}$  = 520 degrees Rankine.

$T_i$  = Temperature at which flow is measured ( $^\circ\text{R}$ ).

$P_i$  = Absolute pressure at which flow is measured (atm).

1,440 = Conversion factor (minutes/day).

0.454/1,000 = Conversion factor (metric ton/lb).

- (1) Values for  $V$ ,  $C$ ,  $T$ ,  $P$ , and, if applicable,  $(f_{\text{H}_2\text{O}})$ , must be based on measurements taken at least once each calendar week with at least 3 days between measurements. If measurements are taken more frequently than once per week, then use the average value for all measurements taken that week. If continuous measurements are taken, then use the average values over the time period of continuous monitoring when the continuous monitoring equipment is properly functioning.
- (2) Quarterly total  $\text{CH}_4$  liberated from degasification systems for the mine must be determined as the sum of  $\text{CH}_4$  liberated determined at each of the monitoring points in the mine, summed over the number of weeks in the quarter, as follows:

$$CH_{4DTotal} = \sum_{j=1}^m \sum_{i=1}^w (CH_{4D})_{i,j} \quad (\text{Eq. FF-4})$$

Where:

$CH_{4DTotal}$  = Quarterly  $CH_4$  liberated from all degasification monitoring points (metric tons  $CH_4$ ).

$(CH_{4D})_{i,j}$  = Weekly  $CH_4$  liberated from a degasification monitoring point (metric tons  $CH_4$ ).

$m$  = Number of monitoring points.

$w$  = Number of weeks in the quarter during which the degasification system is operated.

- (c) If gas from a degasification system or ventilation system is sold, used onsite, or otherwise destroyed (including by flaring or VAM oxidation), you must calculate the quarterly  $CH_4$  destroyed for each destruction device and each point of offsite transport to a destruction device, using Equation FF-5 of this section. You must measure  $CH_4$  content and flow rate according to the provisions in § 98.324, and calculate the methane routed to the destruction device ( $CH_4$ ) using either Equation FF-1 or Equation FF-4 of this section, as applicable.

$$CH_{4Destroyed} = CH_4 \times DE \quad (\text{Eq. FF-5})$$

Where:

$CH_{4Destroyed}$  = Quarterly  $CH_4$  destroyed (metric tons).

$CH_4$  = Quarterly  $CH_4$  routed to the destruction device or offsite transfer point (metric tons).

$DE$  = Destruction efficiency (lesser of manufacturer's specified destruction efficiency and 0.99). If the gas is transported off-site for destruction, use  $DE = 1$ .

- (1) Calculate total  $CH_4$  destroyed as the sum of the methane destroyed at all destruction devices (onsite and offsite), using Equation FF-6 of this section.

$$CH_{4DestroyedTotal} = \sum_{i=1}^d (CH_{4Destroyed})_i \quad (\text{Eq. FF-6})$$

Where:

$CH_{4DestroyedTotal}$  = Quarterly total  $CH_4$  destroyed at the mine (metric tons  $CH_4$ ).

$CH_{4Destroyed}$  = Quarterly  $CH_4$  destroyed from each destruction device or offsite transfer point.

$d$  = Number of onsite destruction devices and points of offsite transport.

- (2) [Reserved]



- (d) You must calculate the quarterly measured net CH<sub>4</sub> emissions to the atmosphere using Equation FF-7 of this section.

$$\text{CH}_4 \text{ emitted (net)} = \text{CH}_{4\text{VTotal}} + \text{CH}_{4\text{DTTotal}} - \text{CH}_{4\text{DestroyedTotal}} \quad (\text{Eq. FF-7})$$

Where:

CH<sub>4</sub> emitted (net) = Quarterly CH<sub>4</sub> emissions from the mine (metric tons).

CH<sub>4VTotal</sub> = Quarterly sum of the CH<sub>4</sub> liberated from all mine ventilation monitoring points (CH<sub>4V</sub>), calculated using Equation FF-2 of this section (metric tons).

CH<sub>4DTTotal</sub> = Quarterly sum of the CH<sub>4</sub> liberated from all mine degasification monitoring points (CH<sub>4D</sub>), calculated using Equation FF-4 of this section (metric tons).

CH<sub>4DestroyedTotal</sub> = Quarterly sum of the measured CH<sub>4</sub> destroyed from all mine ventilation and degasification systems, calculated using Equation FF-6 of this section (metric tons).

- (e) For the methane collected from degasification and/or ventilation systems that is destroyed on site and is not a fuel input for energy generation or use (those emissions are monitored and reported under Subpart C of this part), you must estimate the CO<sub>2</sub> emissions using Equation FF-8 of this section.

$$\text{CO}_2 = \text{CH}_{4\text{Destroyedonsite}} \times 44/16 \quad (\text{Eq. FF-8})$$

Where:

CO<sub>2</sub> = Total quarterly CO<sub>2</sub> emissions from CH<sub>4</sub> destruction (metric tons).

CH<sub>4Destroyedonsite</sub> = Quarterly sum of the CH<sub>4</sub> destroyed, calculated as the sum of CH<sub>4</sub> destroyed for each onsite, non-energy use, as calculated individually in Equation FF-5 of this section (metric tons).

44/16 = Ratio of molecular weights of CO<sub>2</sub> to CH<sub>4</sub>.

[75 FR 39763, July 12, 2010, as amended at 76 FR 73901, Nov. 29, 2011; 78 FR 71967, Nov. 29, 2013; 81 FR 89264, Dec. 9, 2016; 89 FR 31938, Apr. 25, 2024]

## § 98.324 Monitoring and QA/QC requirements.

- (a) For calendar year 2011 monitoring, the facility may submit a request to the Administrator to use one or more best available monitoring methods as listed in § 98.3(d)(1)(i) through (iv). The request must be submitted no later than October 12, 2010 and must contain the information in § 98.3(d)(2)(ii). To obtain approval, the request must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by January 1, 2011. The use of best available monitoring methods will not be approved beyond December 31, 2011.

- (b) For CH<sub>4</sub> liberated from ventilation systems, determine whether CH<sub>4</sub> will be monitored from each ventilation shaft and vent hole, from a centralized monitoring point, or from a combination of the two options. Operators are allowed flexibility for aggregating emissions from more than one ventilation point, as long as emissions from all are addressed, and the methodology for calculating total emissions documented. Monitor by one of the following options:
- (1) Collect quarterly or more frequent grab samples (with no fewer than 6 weeks between measurements) for methane concentration and make quarterly measurements of flow rate, temperature, pressure, and, if applicable, moisture content. The sampling and measurements must be made at the same locations as Mine Safety and Health Administration (MSHA) inspection samples are taken, and should be taken when the mine is operating under normal conditions. You must follow MSHA sampling procedures as set forth in the MSHA Handbook entitled, Coal Mine Safety and Health General Inspection Procedures Handbook, Handbook Number: PH16-V-1 (incorporated by reference, see § 98.7). You must record the date of sampling, flow, temperature, pressure, and moisture measurements, the methane concentration (percent), the bottle number of samples collected, and the location of the measurement or collection.
  - (2) Obtain results of the quarterly (or more frequent) testing performed by MSHA for the methane flowrate. At the same location and within seven days of the MSHA sampling, make measurements of temperature and pressure using the same procedures specified in paragraph (b)(1) of this section. The annual average barometric pressure from the nearest National Oceanic and Atmospheric Administration (NOAA) weather service station may be used as a default for pressure. If the MSHA data for methane flow is provided in the units of actual cubic feet of methane per day, the methane flow data is inserted into Equation FF-1 of this section in place of the value for V and the variables MCF, C/100%, and 1440 are removed from the equation.
  - (3) Monitor emissions through the use of one or more continuous emission monitoring systems (CEMS). If operators use CEMS as the basis for emissions reporting, they must provide documentation on the process for using data obtained from their CEMS to estimate emissions from their mine ventilation systems.
- (c) For CH<sub>4</sub> liberated at degasification systems, determine whether CH<sub>4</sub> will be monitored from each well and gob gas vent hole, from a centralized monitoring point, or from a combination of the two options. Operators are allowed flexibility for aggregating emissions from more than one well or gob gas vent hole, as long as emissions from all are addressed, and the methodology for calculating total emissions is documented. Monitor both gas volume and methane concentration by one of the following two options:
- (1) Monitor emissions through the use of one or more continuous emissions monitoring systems (CEMS). If operators use CEMS as the basis for emissions reporting, they must provide documentation on the process for using data obtained from their CEMS to estimate emissions from their mine ventilation systems.
  - (2) Collect weekly (once each calendar week, with at least three days between measurements) or more frequent samples, for all degasification wells and gob gas vent holes. Determine weekly or more frequent flow rates, methane concentration, temperature, and pressure from these degasification wells and gob gas vent holes. Methane composition should be determined either by submitting samples to a lab for analysis, or from the use of methanometers at the degasification monitoring site. Follow the sampling protocols for sampling of methane emissions from ventilation shafts, as described in § 98.324(b)(1). You must record the date of sampling, flow, temperature, pressure, and moisture measurements, the methane concentration (percent), the bottle number of samples collected, and the location of the measurement or collection.

- (3) If the CH<sub>4</sub> concentration is determined on a dry basis and flow is determined on a wet basis or CH<sub>4</sub> concentration is determined on a wet basis and flow is determined on a dry basis, and the flow meter does not automatically correct for moisture content, determine the moisture content in the gas in a location near or representative of the location of:
- (i) The gas flow meter at least once each calendar week; if measuring with CEMS. If only one measurement is made each calendar week, there must be at least three days between measurements; and
  - (ii) The grab sample, if using grab samples, at the time of the sample.
- (d) Monitoring must adhere to one of the methods specified in paragraphs (d)(1) through (d)(2) of this section.
- (1) ASTM D1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography; ASTM D1946-90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography; ASTM D4891-89 (Reapproved 2006), Standard Test Method for Heating Value of Gases in Natural Gas Range by Stoichiometric Combustion; or ASTM UOP539-97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).
- (2) As an alternative to the gas chromatography methods provided in paragraph (d)(1) of this section, you may use gaseous organic concentration analyzers and a correction factor to calculate the CH<sub>4</sub> concentration following the requirements in paragraphs (d)(2)(i) through (d)(2)(iii) of this section.
- (i) Use Method 25A or 25B at 40 CFR part 60, appendix A-7 to determine gaseous organic concentration as required in § 98.323 and in paragraphs (b) and (c) of this section. You must calibrate the instrument with CH<sub>4</sub> and determine the total gaseous organic concentration as carbon (or as CH<sub>4</sub>; K = 1 in Equation 25A-1 of Method 25A at 40 CFR part 60, appendix A-7).
  - (ii) Determine a correction factor that will be used with the gaseous organic concentrations measured in paragraph (i) of this section. The correction factor must be determined at the routine sampling location no less frequently than once a reporting year following the requirements in paragraphs (d)(2)(ii)(A) through (d)(2)(ii)(C) of this section.
    - (A) Take a minimum of three grab samples of the gas with a minimum of 20 minutes between samples and determine the methane composition of the gas using one of the methods specified in paragraph (d)(1) of this section.
    - (B) As soon as practical after each grab sample is collected and prior to the collection of a subsequent grab sample, determine the gaseous organic concentration of the gas using either Method 25A or 25B at 40 CFR part 60, appendix A-7 as specified in paragraph (d)(2)(i) of this section.
    - (C) Determine the arithmetic average methane concentration and the arithmetic average gaseous organic concentration of the samples analyzed according to paragraphs (d)(2)(ii)(A) and (d)(2)(ii)(B) of this section, respectively, and calculate the non-methane organic carbon correction factor as the ratio of the average methane concentration to the average total gaseous organic concentration. If the ratio exceeds 1, use 1 for the correction factor.
  - (iii) Calculate the CH<sub>4</sub> concentration as specified in Equation FF-9 of this section:

$$C_{CH_4} = f_{NMOC} \times C_{TGOC} \quad (\text{Eq. FF-9})$$

Where:

$C_{CH_4}$  = Methane ( $CH_4$ ) concentration in the gas (volume %) for use in Equations FF-1 and FF-3 of this subpart.

$f_{NMOC}$  = Correction factor from the most recent determination of the correction factor as specified in paragraph (d)(2)(ii) of this section (unitless).

$C_{TGO C}$  = Gaseous organic carbon concentration measured using Method 25A or 25B at 40 CFR part 60, appendix A-7 during routine monitoring of the gas (volume %).

- (e) All flow meters and gas composition monitors that are used to provide data for the GHG emissions calculations shall be calibrated prior to the first reporting year, using the applicable methods specified in paragraphs (d), and (e)(1) through (e)(7) of this section. Alternatively, calibration procedures specified by the flow meter manufacturer may be used. Flow meters and gas composition monitors shall be recalibrated either at the minimum frequency specified by the manufacturer or annually. The operator shall operate, maintain, and calibrate a gas composition monitor capable of measuring the concentration of  $CH_4$  in the gas using one of the methods specified in paragraph (d) of this section. The operator shall operate, maintain, and calibrate the flow meter using any of the following test methods or follow the procedures specified by the flow meter manufacturer. Flow meters must meet the accuracy requirements in § 98.3(i).
- (1) ASME MFC-3M-2004, Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, see § 98.7).
  - (2) ASME MFC-4M-1986 (Reaffirmed 1997), Measurement of Gas Flow by Turbine Meters (incorporated by reference, see § 98.7).
  - (3) ASME MFC-6M-1998, Measurement of Fluid Flow in Pipes Using Vortex Flowmeters (incorporated by reference, see § 98.7).
  - (4) ASME MFC-7M-1987 (Reaffirmed 1992), Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles (incorporated by reference, see § 98.7).
  - (5) ASME MFC-11M-2006 Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters (incorporated by reference, see § 98.7).
  - (6) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters (incorporated by reference, see § 98.7).
  - (7) ASME MFC-18M-2001 Measurement of Fluid Flow using Variable Area Meters (incorporated by reference, see § 98.7).
- (f) For  $CH_4$  destruction,  $CH_4$  must be monitored at each onsite destruction device and each point of offsite transport for combustion using continuous monitors of gas routed to the device or point of offsite transport.
- (g) All temperature, pressure, and moisture content monitors must be operated and calibrated using the procedures and frequencies specified by the manufacturer.

- (h) The owner or operator shall document the procedures used to ensure the accuracy of gas flow rate, gas composition, temperature, pressure, and moisture content measurements. These procedures include, but are not limited to, calibration of flow meters, and other measurement devices. The estimated accuracy of measurements and the technical basis for the estimated accuracy shall be recorded.

[75 FR 39763, July 12, 2010, as amended at 76 FR 73901, Nov. 29, 2011; 78 FR 71967, Nov. 29, 2013; 81 FR 89265, Dec. 9, 2016]

### § 98.325 Procedures for estimating missing data.

- (a) A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required fuel sample is not taken), a substitute data value for the missing parameter shall be used in the calculations, in accordance with paragraph (b) of this section.
- (b) For each missing value of CH<sub>4</sub> concentration, flow rate, temperature, pressure, and moisture content for ventilation and degasification systems, the substitute data value shall be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.

[75 FR 39763, July 12, 2010, as amended at 76 FR 73903, Nov. 29, 2011]

### § 98.326 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information for each mine:

- (a) Quarterly CH<sub>4</sub> liberated from each ventilation monitoring point, (metric tons CH<sub>4</sub>). Where MSHA reports are the monitoring method chosen under § 98.324(b), each annual report must include the MSHA reports used to report quarterly CH<sub>4</sub> concentration and volumetric flow rate as attachments.
- (b) Weekly CH<sub>4</sub> liberated from each degasification system monitoring point (metric tons CH<sub>4</sub>).
- (c) Quarterly CH<sub>4</sub> destruction at each ventilation and degasification system destruction device or point of offsite transport (metric tons CH<sub>4</sub>).
- (d) Quarterly CH<sub>4</sub> emissions (net) from all ventilation and degasification systems (metric tons CH<sub>4</sub>).
- (e) Quarterly CO<sub>2</sub> emissions from on-site destruction of coal mine gas CH<sub>4</sub>, where the gas is not a fuel input for energy generation or use (e.g., flaring) (metric tons CO<sub>2</sub>).
- (f) Quarterly volumetric flow rate for each ventilation monitoring point and units of measure (scfm or acfm), date and location of each measurement, and method of measurement (quarterly sampling or continuous monitoring), used in Equation FF-1 of this subpart. Specify whether the volumetric flow rate measurement at each ventilation monitoring point is on dry basis or wet basis; and, if a flow meter is used, indicate whether or not the flow meter automatically corrects for moisture content.
- (g) Quarterly CH<sub>4</sub> concentration for each ventilation monitoring point, dates and locations of each measurement, and method of measurement (sampling or continuous monitoring). Specify whether the CH<sub>4</sub> concentration measurement at each ventilation monitoring point is on dry basis or wet basis.

- (h) Weekly volumetric flow rate used to calculate CH<sub>4</sub> liberated from degasification systems and units of measure (acfm or scfm), and method of measurement (sampling or continuous monitoring), used in Equation FF-3 of this subpart. Specify whether the volumetric flow rate measurement at each degasification monitoring point is on dry basis or wet basis; and, if a flow meter is used, indicate whether or not the flow meter automatically corrects for moisture content.
- (i) Quarterly CH<sub>4</sub> concentration (%) used to calculate CH<sub>4</sub> liberated from degasification systems, and if the data is based on CEMS or weekly sampling. Specify whether the CH<sub>4</sub> concentration measurement at each degasification monitoring point is on dry basis or wet basis.
- (j) Weekly volumetric flow rate used to calculate CH<sub>4</sub> destruction for each destruction device and each point of offsite transport, and units of measure (acfm or scfm).
- (k) Weekly CH<sub>4</sub> concentration (%) used to calculate CH<sub>4</sub> flow to each destruction device and each point of offsite transport (C).
- (l) Dates in quarterly reporting period where active ventilation of mining operations is taking place.
- (m) Dates in quarterly reporting period where degasification of mining operations is taking place.
- (n) Dates in quarterly reporting period when continuous monitoring equipment is not properly functioning, if applicable.
- (o) Temperature (°R), pressure (atm), moisture content (if applicable), and the moisture correction factor (if applicable) used in Equations FF-1 and FF-3 of this subpart; and the gaseous organic concentration correction factor, if Equation FF-9 of this subpart was required. Moisture content is required to be reported only if CH<sub>4</sub> concentration is measured on a wet basis and volumetric flow is measured on a dry basis, if CH<sub>4</sub> concentration is measured on a dry basis and volumetric flow is measured on a wet basis; and, if a flow meter is used, the flow meter does not automatically correct for moisture content.
- (p) For each destruction device, a description of the device, including an indication of whether destruction occurs at the coal mine or off-site. If destruction occurs at the mine, also report an indication of whether a back-up destruction device is present at the mine, the annual operating hours for the primary destruction device, the annual operating hours for the back-up destruction device (if present), and the destruction efficiencies assumed (percent).
- (q) A description of the gas collection system (manufacturer, capacity, and number of wells) the surface area of the gas collection system (square meters), and the annual operating hours of the gas collection system.
- (r) Identification information and description for each well, shaft, and vent hole, including paragraphs (r)(1) through (r)(3) of this section:
  - (1) Indication of whether the well, shaft, or vent hole is monitored individually, or as part of a centralized monitoring point. Note which method (sampling or continuous monitoring) was used.
  - (2) Start date and close date of each well, shaft, and vent hole. If the well, shaft, or vent hole is operating through the end of the reporting year, December 31st of the reporting year shall be the close date for purposes of reporting.
  - (3) Number of days the well, shaft, or vent hole was in operation during the reporting year. To obtain the number of days in the reporting year, divide the total number of hours that the system was in operation by 24 hours per day.

- (s) For each centralized monitoring point, identification of the wells and shafts included in the point. Note which method (sampling or continuous monitoring) was used.
- (t) Mine Safety and Health Administration (MSHA) identification number for this coal mine.

[75 FR 39763, July 12, 2010, as amended at 76 FR 73903, Nov. 29, 2011; 78 FR 71967, Nov. 29, 2013; 81 FR 89265, Dec. 9, 2016; 89 FR 31938, Apr. 25, 2024]

### **§ 98.327 Records that must be retained.**

In addition to the information required by § 98.3(g), you must retain the following records:

- (a) Calibration records for all monitoring equipment, including the method or manufacturer's specification used for calibration.
- (b) Records of gas sales.
- (c) Logbooks of parameter measurements.
- (d) Laboratory analyses of samples.

### **§ 98.328 Definitions.**

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

### **Subpart GG—Zinc Production**

#### **§ 98.330 Definition of the source category.**

The zinc production source category consists of zinc smelters and secondary zinc recycling facilities.

#### **§ 98.331 Reporting threshold.**

You must report GHG emissions under this subpart if your facility contains a zinc production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

#### **§ 98.332 GHGs to report.**

You must report:

- (a) CO<sub>2</sub> process emissions from each Waelz kiln and electrothermic furnace used for zinc production.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions from each Waelz kiln. You must calculate and report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.
- (c) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit other than Waelz kilns. You must report these emissions under subpart C of this part (General Stationary Fuel Combustion Sources) by following the requirements of subpart C.

#### **§ 98.333 Calculating GHG emissions.**

You must calculate and report the annual process CO<sub>2</sub> emissions using the procedures specified in either paragraph (a) or (b) of this section.

- (a) Calculate and report under this subpart the process or combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part (General Stationary Fuel Combustion Sources).
- (b) Calculate and report under this subpart the process CO<sub>2</sub> emissions by following paragraphs (b)(1) and (b)(2) of this section.
  - (1) For each Waelz kiln or electrothermic furnace at your facility used for zinc production, you must determine the mass of carbon in each carbon-containing material, other than fuel, that is fed, charged, or otherwise introduced into each Waelz kiln and electrothermic furnace at your facility for each year and calculate annual CO<sub>2</sub> process emissions from each affected unit at your facility using equation GG-1 to this section. For electrothermic furnaces, carbon containing input materials include carbon electrodes and carbonaceous reducing agents. For Waelz kilns, carbon containing input materials include carbonaceous reducing agents. If you document that a specific material contributes less than 1 percent of the total carbon into the process, you do not have to include the material in your calculation using equation R-1 to § 98.183.

$$E_{CO_2} = \frac{44}{12} \times \frac{2000}{2205} \times \left[ (Zinc)_k + (C_{Zinc})_k + (Flux)_k + (C_{Flux})_k + (Electrode)_k + (C_{Electrode})_k + (Carbon)_k + (C_{Carbon})_k \right] \quad (\text{Eq. GG-1})$$

Where:

$E_{CO_2k}$  = Annual CO<sub>2</sub> process emissions from individual Waelz kiln or electrothermic furnace “k” (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

2000/2205 = Conversion factor to convert tons to metric tons.

$(Zinc)_k$  = Annual mass of zinc bearing material charged to kiln or furnace “k” (tons).

$(C_{Zinc})_k$  = Carbon content of the zinc bearing material, from the annual carbon analysis for kiln or furnace “k” (percent by weight, expressed as a decimal fraction).

$(Flux)_k$  = Annual mass of flux materials (e.g., limestone, dolomite) charged to kiln or furnace “k” (tons).

$(C_{Flux})_k$  = Carbon content of the flux materials charged to kiln or furnace “k”, from the annual carbon analysis (percent by weight, expressed as a decimal fraction).

$(Electrode)_k$  = Annual mass of carbon electrode consumed in furnace “k” (tons).

$(C_{Electrode})_k$  = Carbon content of the carbon electrode consumed in furnace “k”, from the annual carbon analysis (percent by weight, expressed as a decimal fraction).

$(Carbon)_k$  = Annual mass of carbonaceous materials (e.g., coal, coke) charged to the kiln or furnace “k”(tons).

$(C_{Carbon})_k$  Carbon content of the carbonaceous materials charged to kiln or furnace, “k”, from the annual carbon analysis (percent by weight, expressed as a decimal fraction).



- (2) You must determine the CO<sub>2</sub> emissions from all of the Waelz kilns or electrothermic furnaces at your facility using Equation GG-2 of this section.

$$CO_2 = \sum_{k=1}^n E_{CO_2_k} \quad (\text{Eq. GG-2})$$

Where:

CO<sub>2</sub> = Annual combined CO<sub>2</sub> emissions from all Waelz kilns or electrothermic furnaces (tons).

E<sub>CO<sub>2</sub>k</sub> = Annual CO<sub>2</sub> emissions from each Waelz kiln or electrothermic furnace k calculated using Equation GG-1 of this section (tons).

n = Total number of Waelz kilns or electrothermic furnaces at facility used for the zinc production.

- (c) If GHG emissions from a Waelz kiln or electrothermic furnace are vented through the same stack as any combustion unit or process equipment that reports CO<sub>2</sub> emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part (General Stationary Fuel Combustion Sources), then the calculation methodology in paragraph (b) of this section shall not be used to calculate process emissions. The owner or operator shall report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66470, Oct. 28, 2010; 89 FR 31938, Apr. 25, 2024]

## § 98.334 Monitoring and QA/QC requirements.

If you determine CO<sub>2</sub> emissions using the carbon input procedure in § 98.333(b)(1) and (b)(2), you must meet the requirements specified in paragraphs (a) and (b) of this section.

- (a) Determine the mass of each solid carbon-containing input material consumed using facility instruments, procedures, or records used for accounting purposes including direct measurement weighing or through the use of purchase records same plant instruments or procedures that are used for accounting purposes (such as weigh hoppers, belt weigh feeders, weighed purchased quantities in shipments or containers, combination of bulk density and volume measurements, etc.). Record the total mass for the materials consumed each calendar month and sum the monthly mass to determine the annual mass for each input material.
- (b) For each input material identified in paragraph (a) of this section, you must determine the average carbon content of the material consumed or used in the calendar year using the methods specified in either paragraph (b)(1) or (b)(2) of this section.
- (1) Information provided by your material supplier.
- (2) Collecting and analyzing at least three representative samples of the material using the appropriate testing method. For each carbon-containing input material identified for which the carbon content is not provided by your material supplier, the carbon content of the material must be analyzed at least annually using the appropriate standard methods (and their QA/QC procedures), which are identified in paragraphs (b)(2)(i) through (b)(2)(iii) of this section, as applicable. If you document that a

specific process input or output contributes less than one percent of the total mass of carbon into or out of the process, you do not have to determine the monthly mass or annual carbon content of that input or output.

- (i) Using ASTM E1941-04 Standard Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys (incorporated by reference, see § 98.7), analyze zinc bearing materials.
- (ii) Using ASTM D5373-08 Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Laboratory Samples of Coal (incorporated by reference, see § 98.7), analyze carbonaceous reducing agents and carbon electrodes.
- (iii) Using ASTM C25-06 Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime (incorporated by reference, see § 98.7), analyze flux materials such as limestone or dolomite.

### § 98.335 Procedures for estimating missing data.

For the carbon input procedure in § 98.333(b), a complete record of all measured parameters used in the GHG emissions calculations is required (e.g., raw materials carbon content values, etc.). Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter shall be used in the calculations as specified in paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) For missing records of the carbon content of inputs for facilities that estimate emissions using the carbon input procedure in § 98.333(b), 100 percent data availability is required. You must repeat the test for average carbon contents of inputs according to the procedures in § 98.335(b) if data are missing.
- (b) For missing records of the annual mass of carbon-containing inputs using the carbon input procedure in § 98.333(b), the substitute data value must be based on the best available estimate of the mass of the input material from all available process data or information used for accounting purposes, such as purchase records.

### § 98.336 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) or (b) of this section, as applicable, for each Waelz kiln or electrothermic furnace.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required for the Tier 4 Calculation Methodology in § 98.36 and the information listed in this paragraph (a):
  - (1) Annual zinc product production capacity (tons).
  - (2) Annual production quantity for each zinc product (tons).
  - (3) Annual facility production quantity for each zinc product (tons).
  - (4) Number of Waelz kilns at each facility used for zinc production.
  - (5) Number of electrothermic furnaces at each facility used for zinc production.
  - (6) Total amount of electric arc furnace dust annually consumed by all Waelz kilns at the facility (tons).

- (b) If a CEMS is not used to measure CO<sub>2</sub> emissions, then you must report the information listed in this paragraph (b):
- (1) Identification number and annual process CO<sub>2</sub> emissions from each individual Waelz kiln or electrothermic furnace (metric tons).
  - (2) Annual zinc product production capacity (tons).
  - (3) Annual production quantity for each zinc product (tons).
  - (4) Number of Waelz kilns at each facility used for zinc production.
  - (5) Number of electrothermic furnaces at each facility used for zinc production.
  - (6) Total amount of electric arc furnace dust annually consumed by all Waelz kilns at the facility (tons).
  - (7) [Reserved]
  - (8) Whether carbon content of each carbon-containing input material charged to each kiln or furnace is based on reports from the supplier or through self measurement using applicable ASTM standard method.
  - (9) If carbon content of each carbon-containing input material charged to each kiln or furnace is based on self measurement, the ASTM Standard Test Method used.
  - (10) [Reserved]
  - (11) Whether carbon content of the carbon electrode used in each furnace is based on reports from the supplier or through self measurement using applicable ASTM standard method.
  - (12) If carbon content of carbon electrode used in each furnace is based on self measurement, the ASTM standard method used.
  - (13) If you use the missing data procedures in § 98.335(b), you must report how the monthly mass of carbon-containing materials with missing data was determined and the number of months the missing data procedures were used.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66470, Oct. 28, 2010; 79 FR 63799, Oct. 24, 2014; 89 FR 31938, Apr. 25, 2024]

### § 98.337 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (c) of this section for each zinc production facility.

- (a) If a CEMS is used to measure emissions, then you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37 and the information listed in this paragraph (a):
- (1) Monthly facility production quantity for each zinc product (tons).
  - (2) Annual operating hours for all Waelz kilns and electrothermic furnaces used in zinc production.
- (b) If a CEMS is not used to measure emissions, you must also retain the records specified in paragraphs (b)(1) through (b)(7) of this section.
- (1) Records of all analyses and calculations conducted for data reported as listed in § 98.336(b).

- (2) Annual operating hours for Waelz kilns and electrothermic furnaces used in zinc production.
  - (3) Monthly production quantity for each zinc product (tons).
  - (4) Monthly mass of zinc bearing materials, flux materials (e.g., limestone, dolomite), and carbonaceous materials (e.g., coal, coke) charged to the kiln or furnace (tons).
  - (5) Sampling and analysis records for carbon content of zinc bearing materials, flux materials (e.g., limestone, dolomite), carbonaceous materials (e.g., coal, coke), charged to the kiln or furnace (percent by weight, expressed as a decimal fraction).
  - (6) Monthly mass of carbon electrode consumed in for each electrothermic furnace (tons).
  - (7) Sampling and analysis records for carbon content of electrode materials.
  - (8) You must keep records that include a detailed explanation of how company records of measurements are used to estimate the carbon input to each Waelz kiln or electrothermic furnace, as applicable to your facility, including documentation of any materials excluded from Equation GG-1 of this subpart that contribute less than 1 percent of the total carbon inputs to the process. You also must document the procedures used to ensure the accuracy of the measurements of materials fed, charged, or placed in an affected unit including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (c) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (c)(1) through (9) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (c)(1) through (9) of this section.
- (1) Annual mass of zinc bearing material charged to kiln or furnace (tons) (Equation GG-1 of § 98.333).
  - (2) Carbon content of the zinc bearing material, from the annual carbon analysis for kiln or furnace (percent by weight, expressed as a decimal fraction) (Equation GG-1).
  - (3) Annual mass of flux materials (e.g., limestone, dolomite) charged to each kiln or furnace (tons) (Equation GG-1).
  - (4) Carbon content of the flux materials charged to each kiln or furnace, from the annual carbon analysis (percent by weight, expressed as a decimal fraction) (Equation GG-1).
  - (5) Annual mass of carbon electrode consumed in each furnace (tons) (Equation GG-1).
  - (6) Carbon content of the carbon electrode consumed in each furnace, from the annual carbon analysis (percent by weight, expressed as a decimal fraction) (Equation GG-1).
  - (7) Annual mass of carbonaceous materials (e.g., coal, coke) charged to each kiln or furnace (tons) (Equation GG-1).
  - (8) Carbon content of the carbonaceous materials charged to each kiln or furnace, from the annual carbon analysis (percent by weight, expressed as a decimal fraction) (Equation GG-1).
  - (9) Identify whether each unit is a Waelz kiln or an electrothermic furnace.

[74 FR 56374, Oct. 30, 2009, as amended at 79 FR 63799, Oct. 24, 2014]

## § 98.338 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart HH—Municipal Solid Waste Landfills

### § 98.340 Definition of the source category.

- (a) This source category applies to municipal solid waste (MSW) landfills that accepted waste on or after January 1, 1980, unless all three of the following conditions apply.
  - (1) The MSW landfill did not receive waste on or after January 1, 2013.
  - (2) The MSW landfill had CH<sub>4</sub> generation as determined using Equation HH-5 and, if applicable, Equation HH-7 of this subpart of less than 1,190 metric tons of CH<sub>4</sub> in the 2013 reporting year.
  - (3) The owner or operator of the MSW landfill was not required to submit an annual report under any requirement of this part in any reporting year prior to 2013.
- (b) This source category does not include Resource Conservation and Recovery Act (RCRA) Subtitle C or Toxic Substances Control Act (TSCA) hazardous waste landfills, construction and demolition waste landfills, or industrial waste landfills.
- (c) This source category consists of the following sources at municipal solid waste (MSW) landfills: Landfills, landfill gas collection systems, and landfill gas destruction devices (including flares).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66470, Oct. 28, 2010; 78 FR 71968, Nov. 29, 2013]

### § 98.341 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a MSW landfill and the facility meets the requirements of § 98.2(a)(1).

### § 98.342 GHGs to report.

- (a) You must report CH<sub>4</sub> generation and CH<sub>4</sub> emissions from landfills.
- (b) You must report CH<sub>4</sub> destruction resulting from landfill gas collection and combustion systems.
- (c) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit following the requirements of subpart C.

### § 98.343 Calculating GHG emissions.

- (a) For all landfills subject to the reporting requirements of this subpart, calculate annual modeled CH<sub>4</sub> generation according to the applicable requirements in paragraphs (a)(1) through (a)(3) of this section.
  - (1) Calculate annual modeled CH<sub>4</sub> generation using Equation HH-1 of this section.

$$G_{CH_4} = \sum_{i=1}^{T-1} \left\{ W_i \times MCF \times DOC \times DOC_F \times F \times \frac{16}{12} \times \left( e^{-\frac{1}{2}(T-i-1)} - e^{-\frac{1}{2}(T-i)} \right) \right\} \quad (\text{Eq. HH-1})$$

Where:

$G_{CH_4}$  = Modeled methane generation rate in reporting year T (metric tons  $CH_4$ ).

x = Year in which waste was disposed.

S = Start year of calculation. Use the year 1960 or the opening year of the landfill, whichever is more recent.

T = Reporting year for which emissions are calculated.

$W_x$  = Quantity of waste disposed in the landfill in year x from measurement data, tipping fee receipts, or other company records (metric tons, as received (wet weight)).

MCF = Methane correction factor (fraction). Use the default value of 1 unless there is active aeration of waste within the landfill during the reporting year. If there is active aeration of waste within the landfill during the reporting year, use either the default value of 1 or select an alternative value no less than 0.5 based on site-specific aeration parameters.

DOC = Degradable organic carbon from Table HH-1 of this subpart [fraction (metric tons C/metric ton waste)].

$DOC_F$  = Fraction of DOC dissimilated (fraction). Use the default value of 0.5.

F = Fraction by volume of  $CH_4$  in landfill gas from measurement data for the current reporting year, if available (fraction, dry basis, corrected to 0% oxygen); otherwise, use the default of 0.5.

k = Rate constant from Table HH-1 to this subpart ( $yr^{-1}$ ). Select the most applicable k value for the majority of the past 10 years (or operating life, whichever is shorter).

- (2) For years when material-specific waste quantity data are available, apply equation HH-1 to this section for each waste quantity type and sum the  $CH_4$  generation rates for all waste types to calculate the total modeled  $CH_4$  generation rate for the landfill. Use the appropriate parameter values for k, DOC, MCF,  $DOC_F$ , and F shown in table HH-1 to this subpart. The annual quantity of each type of waste disposed must be calculated as the sum of the daily quantities of waste (of that type) disposed. You may use the uncharacterized MSW parameters for a portion of your waste materials when using the material-specific modeling approach for mixed waste streams that cannot be designated to a specific material type. For years when waste composition data are not available, use the bulk waste parameter values for k and DOC in table HH-1 to this subpart for the total quantity of waste disposed in those years.
- (3) Beginning in the first emissions reporting year and for each year thereafter, if scales are in place, you must determine the annual quantity of waste (in metric tons as received, i.e., wet weight) disposed of in the landfill using paragraph (a)(3)(i) of this section for all containers and for all vehicles used to haul waste to the landfill, except for passenger cars, light duty pickup trucks, or waste loads that cannot be measured using the scales due to physical limitations (load cannot physically access or fit on the scale) and/or operational limitations of the scale (load exceeding the limits or sensitivity range of the scale). If scales are not in place, you must use paragraph (a)(3)(ii) of this section to determine the annual quantity of waste disposed. For waste hauled to the landfill in passenger cars or light duty pickup trucks, you may use either paragraph (a)(3)(i) or paragraph (a)(3)(ii) of this section to determine the annual quantity of waste disposed. For loads that cannot be measured using the scales due to physical and/or operational limitations of the scale, you must use paragraph

(a)(3)(ii) of this section or similar engineering calculations to determine the annual quantity of waste disposed. The approach used to determine the annual quantity of waste disposed of must be documented in the monitoring plan.

- (i) Use direct mass measurements of each individual load received at the landfill using either of the following methods:
    - (A) Weigh using mass scales each vehicle or container used to haul waste as it enters the landfill or disposal area; weigh using mass scales each vehicle or container after it has off-loaded the waste; determine the quantity of waste received from the individual load as the difference in the two mass measurements; and determine the annual quantity of waste received as the sum of all waste loads received during the year. Alternatively, you may determine annual quantity of waste by summing the weights of all vehicles and containers entering the landfill and subtracting from it the sum of all the weights of vehicles and containers after they have off-loaded the waste in the landfill.
    - (B) Weigh using mass scales each vehicle or container used to haul waste as it enters the landfill or disposal area; determine a representative tare weight by vehicle or container type by weighing no less than 5 of each type of vehicle or container after it has off-loaded the waste; determine the quantity of waste received from the individual load as the difference between the measured weight in and the tare weight determined for that container/vehicle type; and determine the annual quantity of waste received as the sum of all waste loads received during the year.
  - (ii) Determine the working capacity in units of mass for each type of container or vehicle used to haul waste to the landfill (e.g., using volumetric capacity and waste density measurements; direct measurement of a selected number of passenger vehicles and light duty pick-up trucks; or similar methods); record the number of loads received at the landfill by vehicle/container type; calculate the annual mass per vehicle/container type as the mass product of the number of loads of that vehicle/container multiplied by its working capacity; and calculate the annual quantity of waste received as the sum of the annual mass per vehicle/container type across all of the vehicle/container types used to haul waste to the landfill.
- (4) For years prior to the first emissions reporting year, use methods in paragraph (a)(3) of this section when waste disposal quantity data are readily available. When waste disposal quantity data are not readily available,  $W_X$  shall be estimated using one of the applicable methods in paragraphs (a)(4)(i) through (a)(4)(iii) of this section. You must determine which method is most applicable to the conditions and disposal history of your facility. Historical waste disposal quantities should only be determined once, as part of the first annual report, and the same values should be used for all subsequent annual reports, supplemented by the next year's data on new waste disposal.
- (i) Assume all prior years waste disposal quantities are the same as the waste quantity in the first year for which waste quantities are available.
  - (ii) Use the estimated population served by the landfill in each year, the values for national average per capita waste disposal rates found in Table HH-2 to this subpart, and calculate the waste quantity landfilled using Equation HH-2 of this section.

$$W_X = POP_X \times WOR_X \quad (\text{Eq. HH-2})$$

where:

$W_x$  = Quantity of waste placed in the landfill in year x (metric tons, wet basis).

$POP_x$  = Population served by the landfill in year x from city population, census data, or other estimates (capita).

$WDR_x$  = Average per capita waste disposal rate for year x from Table HH-2 to this subpart (metric tons per capita per year, wet basis; tons/cap/yr).

- (iii) Use a constant average waste disposal quantity calculated using Equation HH-3 of this section for each year the landfill was in operation (i.e., from the first year accepting waste until the last year for which waste disposal data is unavailable, inclusive).

$$W_x = \frac{LFC}{(YrData - YrOpen + 1)} \quad (\text{Eq. HH-3})$$

where:

$W_x$  = Quantity of waste placed in the landfill in year x (metric tons, wet basis).

LFC = Landfill capacity or, for operating landfills, capacity of the landfill used (or the total quantity of waste-in-place) at the end of the year prior to the year when waste disposal data are available from design drawings or engineering estimates (metric tons).

YrData = Year in which the landfill last received waste or, for operating landfills, the year prior to the first reporting year when waste disposal data is first available from company records, or best available data.

YrOpen = Year in which the landfill first received waste from company records or best available data. If no data are available for estimating YrOpen for a closed landfill, use 30 years as the default operating life of the landfill.

- (b) For landfills with gas collection systems, calculate the quantity of  $CH_4$  destroyed according to the requirements in paragraphs (b)(1) and (b)(2) of this section.

- (1) If you continuously monitor the flow rate,  $CH_4$  concentration, temperature, pressure, and, if necessary, moisture content of the landfill gas that is collected and routed to a destruction device (before any treatment equipment) using a monitoring meter specifically for  $CH_4$  gas, as specified in § 98.344, you must use this monitoring system and calculate the quantity of  $CH_4$  recovered for destruction using Equation HH-4 of this section. A fully integrated system that directly reports  $CH_4$  content requires no other calculation than summing the results of all monitoring periods for a given year.

$$R = \sum_{n=1}^N \left( (V)_n \times (K_{MC})_n \times \frac{(C_{CH_4})_n}{100\%} \times 0.0423 \times \frac{520^\circ R}{(T)_n} \times \frac{(P)_n}{1 \text{ atm}} \times \frac{0.454}{1,000} \right) \quad (\text{Eq. HH-4})$$

where:

R = Annual quantity of recovered  $CH_4$  (metric tons  $CH_4$ ).



$N$  = Total number of measurement periods in a year. Use daily averaging periods for a continuous monitoring system and  $N = 365$  (or  $N = 366$  for leap years). For monthly sampling, as provided in paragraph (b)(2) of this section, use  $N = 12$ .

$n$  = Index for measurement period.

$(V)_n$  = Cumulative volumetric flow for the measurement period in actual cubic feet (acf). If the flow rate meter automatically corrects for temperature and pressure, replace " $520^\circ\text{R}/(T)_n \times (P)_n/1 \text{ atm}$ " with "1".

$(K_{MC})_n$  = Moisture correction term for the measurement period, volumetric basis, as follows:  $(K_{MC})_n = 1$  when  $(V)_n$  and  $(C)_n$  are both measured on a dry basis or if both are measured on a wet basis;  $(K_{MC})_n = [1 - (f_{H_2O})_n]$  when  $(V)_n$  is measured on a wet basis and  $(C)_n$  is measured on a dry basis; and  $(K_{MC})_n = 1/[1 - (f_{H_2O})_n]$  when  $(V)_n$  is measured on a dry basis and  $(C)_n$  is measured on a wet basis.

$(f_{H_2O})_n$  = Average moisture content of landfill gas during the measurement period, volumetric basis (cubic feet water per cubic feet landfill gas)

$(C_{CH_4})_n$  = Average  $CH_4$  concentration of landfill gas for the measurement period (volume %).

0.0423 = Density of  $CH_4$  lb/cf at  $520^\circ\text{R}$  or 60 degrees Fahrenheit and 1 atm.

$(T)_n$  = Average temperature at which flow is measured for the measurement period ( $^\circ\text{R}$ ).

$(P)_n$  = Average pressure at which flow is measured for the measurement period (atm).

0.454/1,000 = Conversion factor (metric ton/lb).

(2) If you do not continuously monitor according to paragraph (b)(1) of this section, you must determine the flow rate,  $CH_4$  concentration, temperature, pressure, and moisture content of the landfill gas that is collected and routed to a destruction device (before any treatment equipment) according to the requirements in paragraphs (b)(2)(i) through (b)(2)(iii) of this section and calculate the quantity of  $CH_4$  recovered for destruction using Equation HH-4 of this section.

(i) Continuously monitor gas flow rate and determine the cumulative volume of landfill gas each month and the cumulative volume of landfill gas each year that is collected and routed to a destruction device (before any treatment equipment). Under this option, the gas flow meter is not required to automatically correct for temperature, pressure, or, if necessary, moisture content. If the gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content, you must determine these parameters as specified in paragraph (b)(2)(iii) of this section.

(ii) Determine the  $CH_4$  concentration in the landfill gas that is collected and routed to a destruction device (before any treatment equipment) in a location near or representative of the location of the gas flow meter at least once each calendar month; if only one measurement is made each calendar month, there must be at least fourteen days between measurements.

(iii) If the gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content:

- (A) Determine the temperature and pressure in the landfill gas that is collected and routed to a destruction device (before any treatment equipment) in a location near or representative of the location of the gas flow meter at least once each calendar month; if only one measurement is made each calendar month, there must be at least fourteen days between measurements.
- (B) If the CH<sub>4</sub> concentration is determined on a dry basis and flow is determined on a wet basis or CH<sub>4</sub> concentration is determined on a wet basis and flow is determined on a dry basis, and the flow meter does not automatically correct for moisture content, determine the moisture content in the landfill gas that is collected and routed to a destruction device (before any treatment equipment) in a location near or representative of the location of the gas flow meter at least once each calendar month; if only one measurement is made each calendar month, there must be at least fourteen days between measurements.
- (c) For all landfills, calculate CH<sub>4</sub> generation (adjusted for oxidation in cover materials) and actual CH<sub>4</sub> emissions (taking into account any CH<sub>4</sub> recovery, and oxidation in cover materials) according to the applicable methods in paragraphs (c)(1) through (c)(3) of this section.
  - (1) Calculate CH<sub>4</sub> generation, adjusted for oxidation, from the modeled CH<sub>4</sub> (G<sub>CH<sub>4</sub></sub> from Equation HH-1 of this section) using Equation HH-5 of this section.

$$MG = G_{CH_4} \times (1 - OX) \quad (\text{Eq. HH-5})$$

Where:

MG = Methane generation, adjusted for oxidation, from the landfill in the reporting year (metric tons CH<sub>4</sub>).

G<sub>CH<sub>4</sub></sub> = Modeled methane generation rate in reporting year from Equation HH-1 of this section (metric tons CH<sub>4</sub>).

OX = Oxidation fraction. Use the appropriate oxidation fraction default value from Table HH-4 of this subpart.

- (2) For landfills that do not have landfill gas collection systems, the CH<sub>4</sub> emissions are equal to the CH<sub>4</sub> generation (MG) calculated in Equation HH-5 of this section.
- (3) For landfills with landfill gas collection systems, calculate CH<sub>4</sub> emissions using the methodologies specified in paragraphs (c)(3)(i) and (ii) of this section.
  - (i) Calculate CH<sub>4</sub> emissions from the modeled CH<sub>4</sub> generation and measured CH<sub>4</sub> recovery using equation HH-6 to this section.

$$\text{Emissions} = \left[ (G_{CH_4} - \sum_{n=1}^N R_n) \times (1 - OX) + \sum_{n=1}^N \{ R_n \times (1 - (DE_n \times F_{Dest,n})) \} \right] \quad (\text{Eq. HH-6})$$

Where:

Emissions = Methane emissions from the landfill in the reporting year (metric tons CH<sub>4</sub>).

G<sub>CH<sub>4</sub></sub> = Modeled methane generation rate in reporting year from equation HH-1 to this section or the quantity of recovered CH<sub>4</sub> from equation HH-4 to this section, whichever is greater (metric tons CH<sub>4</sub>).

N = Number of landfill gas measurement locations (associated with a destruction device or gas sent off-site). If a single monitoring location is used to monitor volumetric flow and CH<sub>4</sub> concentration of the recovered gas sent to one or multiple destruction devices, then N = 1.

R<sub>n</sub> = Quantity of recovered CH<sub>4</sub> from equation HH-4 to this section for the nth measurement location (metric tons CH<sub>4</sub>).

OX = Oxidation fraction. Use the appropriate oxidation fraction default value from table HH-4 to this subpart.

DE<sub>n</sub> = Destruction efficiency (lesser of manufacturer's specified destruction efficiency and 0.99) for the nth measurement location. If the gas is transported off-site for destruction, use DE = 1. If the volumetric flow and CH<sub>4</sub> concentration of the recovered gas is measured at a single location providing landfill gas to multiple destruction devices (including some gas destroyed on-site and some gas sent off-site for destruction), calculate DE<sub>n</sub> as the arithmetic average of the DE values determined for each destruction device associated with that measurement location.

f<sub>Dest,n</sub> = Fraction of hours the destruction device associated with the nth measurement location was operating during active gas flow calculated as the annual operating hours for the destruction device divided by the annual hours flow was sent to the destruction device. The annual operating hours for the destruction device should include only those periods when flow was sent to the destruction device and the destruction device was operating at its intended temperature or other parameter indicative of effective operation. For flares, times when there is no flame present must be excluded from the annual operating hours for the destruction device. If the gas is transported off-site for destruction, use f<sub>Dest,n</sub> = 1. If the volumetric flow and CH<sub>4</sub> concentration of the recovered gas is measured at a single location providing landfill gas to multiple destruction devices (including some gas destroyed on-site and some gas sent off-site for destruction), calculate f<sub>Dest,n</sub> as the arithmetic average of the f<sub>Dest</sub> values determined for each destruction device associated with that measurement location.

- (ii) Calculate CH<sub>4</sub> generation and CH<sub>4</sub> emissions using measured CH<sub>4</sub> recovery and estimated gas collection efficiency and equations HH-7 and HH-8 to this section.

$$MG = \left[ \frac{1}{CE} \sum_{C=1}^C \left[ \frac{\sum_{X=1}^X R_{X,C}}{f_{Rec,C}} \right] \times (1 - OX) \right] \quad (\text{Eq. HH-7})$$

$$\text{Emissions} = \left[ \left( \frac{1}{CE} \sum_{C=1}^C \left[ \frac{\sum_{X=1}^X R_{X,C}}{f_{Rec,C}} \right] - \sum_{n=1}^N R_n \right) \times (1 - OX) + \sum_{n=1}^N \left\{ R_n \times \left( 1 - (DE_n \times f_{Dest,n}) \right) \right\} \right] \quad (\text{Eq. HH-8})$$

Where:

MG = Methane generation, adjusted for oxidation, from the landfill in the reporting year (metric tons CH<sub>4</sub>).

Emissions = Methane emissions from the landfill in the reporting year (metric tons CH<sub>4</sub>).

C = Number of landfill gas collection systems operated at the landfill.

X = Number of landfill gas measurement locations associated with landfill gas collection system "c".

N = Number of landfill gas measurement locations (associated with a destruction device or gas sent off-site). If a single monitoring location is used to monitor volumetric flow and CH<sub>4</sub> concentration of the recovered gas sent to one or multiple destruction devices, then N = 1. Note that  $N = \sum_{(c=1)}^C [\sum_{(x=1)}^X [1]]$ .

R<sub>x,c</sub> = Quantity of recovered CH<sub>4</sub> from equation HH-4 to this section for the xth measurement location for landfill gas collection system "c" (metric tons CH<sub>4</sub>).

R<sub>n</sub> = Quantity of recovered CH<sub>4</sub> from equation HH-4 to this section for the nth measurement location (metric tons CH<sub>4</sub>).

CE = Collection efficiency estimated at landfill, taking into account system coverage, operation, measurement practices, and cover system materials from table HH-3 to this subpart. If area by soil cover type information is not available, use applicable default value for CE4 in table HH-3 to this subpart for all areas under active influence of the collection system.

f<sub>Rec,c</sub> = Fraction of hours the landfill gas collection system "c" was operating normally (annual operating hours/8760 hours per year or annual operating hours/8784 hours per year for a leap year). Do not include periods of shutdown or poor operation, such as times when pressure, temperature, or other parameters indicative of operation are outside of normal variances, in the annual operating hours.

OX = Oxidation fraction. Use appropriate oxidation fraction default value from table HH-4 to this subpart.

DE<sub>n</sub> = Destruction efficiency, (lesser of manufacturer's specified destruction efficiency and 0.99) for the nth measurement location. If the gas is transported off-site for destruction, use DE = 1. If the volumetric flow and CH<sub>4</sub> concentration of the recovered gas is measured at a single location providing landfill gas to multiple destruction devices (including some gas destroyed on-site and some gas sent off-site for destruction), calculate DE<sub>n</sub> as the arithmetic average of the DE values determined for each destruction device associated with that measurement location.

f<sub>Dest,n</sub> = Fraction of hours the destruction device associated with the nth measurement location was operating during active gas flow calculated as the annual operating hours for the destruction device divided by the annual hours flow was sent to the destruction device. The annual operating hours for the destruction device should include only those periods when flow was sent to the destruction device and the destruction device was operating at its intended temperature or other parameter indicative of effective operation. For flares, times when there is no flame present must be excluded from the annual operating hours for the destruction device. If the gas is transported off-site for destruction, use f<sub>Dest,n</sub> = 1. If the volumetric flow and CH<sub>4</sub> concentration of the recovered gas is measured at a single location providing landfill gas to multiple destruction devices (including some gas destroyed on-site and some gas sent off-site for destruction), calculate f<sub>Dest,n</sub> as the arithmetic average of the f<sub>Dest</sub> values determined for each destruction device associated with that measurement location.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66470, Oct. 28, 2010; 78 FR 71968, Nov. 29, 2013; 89 FR 31938, Apr. 25, 2024]

## § 98.344 Monitoring and QA/QC requirements.

- (a) Mass measurement equipment used to determine the quantity of waste landfilled on or after January 1, 2010 must meet the requirements for weighing equipment as described in “Specifications, Tolerances, and Other Technical Requirements For Weighing and Measuring Devices” NIST Handbook 44 (2009) (incorporated by reference, see § 98.7).
- (b) For landfills with gas collection systems, operate, maintain, and calibrate a gas composition monitor capable of measuring the concentration of CH<sub>4</sub> in the recovered landfill gas using one of the methods specified in paragraphs (b)(1) through (b)(6) of this section or as specified by the manufacturer. Gas composition monitors shall be calibrated prior to the first reporting year and recalibrated either annually or at the minimum frequency specified by the manufacturer, whichever is more frequent, or whenever the error in the midrange calibration check exceeds ±10 percent.
  - (1) Method 18 at 40 CFR part 60, appendix A-6.
  - (2) ASTM D1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (3) ASTM D1946-90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference, see § 98.7).
  - (4) GPA Standard 2261-00, Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography.
  - (5) UOP539-97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).
  - (6) As an alternative to the gas chromatography methods provided in paragraphs (b)(1) through (b)(5) of this section, you may use total gaseous organic concentration analyzers and calculate the methane concentration following the requirements in paragraphs (b)(6)(i) through (b)(6)(iii) of this section.
    - (i) Use Method 25A or 25B at 40 CFR part 60, appendix A-7 to determine total gaseous organic concentration. You must calibrate the instrument with methane and determine the total gaseous organic concentration as carbon (or as methane; K = 1 in Equation 25A-1 of Method 25A at 40 CFR part 60, appendix A-7).
    - (ii) Determine a non-methane organic carbon correction factor at the routine sampling location no less frequently than once a reporting year following the requirements in paragraphs (b)(6)(ii)(A) through (b)(6)(ii)(C) of this section.
      - (A) Take a minimum of three grab samples of the landfill gas with a minimum of 20 minutes between samples and determine the methane composition of the landfill gas using one of the methods specified in paragraphs (b)(1) through (b)(5) of this section.
      - (B) As soon as practical after each grab sample is collected and prior to the collection of a subsequent grab sample, determine the total gaseous organic concentration of the landfill gas using either Method 25A or 25B at 40 CFR part 60, appendix A-7 as specified in paragraph (b)(6)(i) of this section.
      - (C) Determine the arithmetic average methane concentration and the arithmetic average total gaseous organic concentration of the samples analyzed according to paragraphs (b)(6)(ii)(A) and (b)(6)(ii)(B) of this section, respectively, and calculate the non-methane

organic carbon correction factor as the ratio of the average methane concentration to the average total gaseous organic concentration. If the ratio exceeds 1, use 1 for the non-methane organic carbon correction factor.

- (iii) Calculate the methane concentration as specified in Equation HH-9 of this section.

$$C_{CH_4} = f_{NMOC} \times C_{TGOC} \quad (\text{Eq. HH-9})$$

Where:

$C_{CH_4}$  = Methane concentration in the landfill gas (volume %) for use in Equation HH-4 of this subpart.

$f_{NMOC}$  = Non-methane organic carbon correction factor from the most recent determination of the non-methane organic carbon correction factor as specified in paragraph (b)(6)(ii) of this section (unitless).

$C_{TGOC}$  = Total gaseous organic carbon concentration measured using Method 25A or 25B at 40 CFR part 60, appendix A-7 during routine monitoring of the landfill gas (volume %).

- (c) For landfills with gas collection systems, install, operate, maintain, and calibrate a gas flow meter capable of measuring the volumetric flow rate of the recovered landfill gas using one of the methods specified in paragraphs (c)(1) through (c)(8) of this section or as specified by the manufacturer. Each gas flow meter shall be recalibrated either biennially (every 2 years) or at the minimum frequency specified by the manufacturer. Except as provided in § 98.343(b)(2)(i), each gas flow meter must be capable of correcting for the temperature and pressure and, if necessary, moisture content.
- (1) ASME MFC-3M-2004, Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, see § 98.7).
  - (2) ASME MFC-4M-1986 (Reaffirmed 1997), Measurement of Gas Flow by Turbine Meters (incorporated by reference, see § 98.7).
  - (3) ASME MFC-6M-1998, Measurement of Fluid Flow in Pipes Using Vortex Flowmeters (incorporated by reference, see § 98.7).
  - (4) ASME MFC-7M-1987 (Reaffirmed 1992), Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles (incorporated by reference, see § 98.7).
  - (5) ASME MFC-11M-2006 Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters (incorporated by reference, see § 98.7). The mass flow must be corrected to volumetric flow based on the measured temperature, pressure, and gas composition.
  - (6) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters (incorporated by reference, see § 98.7).
  - (7) ASME MFC-18M-2001 Measurement of Fluid Flow using Variable Area Meters (incorporated by reference, see § 98.7).
  - (8) Method 2A or 2D at 40 CFR part 60, appendix A-1.
- (d) All temperature, pressure, and if necessary, moisture content monitors must be calibrated using the procedures and frequencies specified by the manufacturer.

- (e) For landfills electing to measure the fraction by volume of CH<sub>4</sub> in landfill gas (F), follow the requirements in paragraphs (e)(1) and (2) of this section.
- (1) Use a gas composition monitor capable of measuring the concentration of CH<sub>4</sub> on a dry basis that is properly operated, calibrated, and maintained according to the requirements specified in paragraph (b) of this section. You must either use a gas composition monitor that is also capable of measuring the O<sub>2</sub> concentration correcting for excess (infiltration) air or you must operate, maintain, and calibrate a second monitor capable of measuring the O<sub>2</sub> concentration on a dry basis according to the manufacturer's specifications.
- (2) Use Equation HH-10 of this section to correct the measured CH<sub>4</sub> concentration to 0% oxygen. If multiple CH<sub>4</sub> concentration measurements are made during the reporting year, determine F separately for each measurement made during the reporting year, and use the results to determine the arithmetic average value of F for use in Equation HH-1 of this part.

$$F = \left( \frac{C_{CH_4}}{100\%} \right) \times \left[ \frac{20.9_c}{(20.9 - \%O_2)} \right] \quad (\text{Eq. HH-10})$$

Where:

F = Fraction by volume of CH<sub>4</sub> in landfill gas (fraction, dry basis, corrected to 0% oxygen).

C<sub>CH<sub>4</sub></sub> = Measured CH<sub>4</sub> concentration in landfill gas (volume %, dry basis).

20.9<sub>c</sub> = Defined O<sub>2</sub> correction basis, (volume %, dry basis).

20.9 = O<sub>2</sub> concentration in air (volume %, dry basis).

%O<sub>2</sub> = Measured O<sub>2</sub> concentration in landfill gas (volume %, dry basis).

- (f) The owner or operator shall document the procedures used to ensure the accuracy of the estimates of disposal quantities and, if applicable, gas flow rate, gas composition, temperature, pressure, and moisture content measurements. These procedures include, but are not limited to, calibration of weighing equipment, fuel flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices, and the technical basis for these estimates shall be recorded.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66472, Oct. 28, 2010; 78 FR 71969, Nov. 29, 2013]

### § 98.345 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required fuel sample is not taken), a substitute data value for the missing parameter shall be used in the calculations, according to the requirements in paragraphs (a) through (c) of this section.

- (a) For each missing value of the CH<sub>4</sub> content, the substitute data value shall be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If the "after" value is not obtained by the end of the reporting year, you may use the "before"



value for the missing data substitution. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.

- (b) For missing gas flow rates, the substitute data value shall be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If the “after” value is not obtained by the end of the reporting year, you may use the “before” value for the missing data substitution. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.
- (c) For missing daily waste disposal quantity data for disposal in the reporting year, the substitute value shall be the average daily waste disposal quantity for that day of the week as measured on the week before and week after the missing daily data.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71970, Nov. 29, 2013]

### § 98.346 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information for each landfill.

- (a) A classification of the landfill as “open” (actively received waste in the reporting year) or “closed” (no longer receiving waste), the year in which the landfill first started accepting waste for disposal, the last year the landfill accepted waste (for open landfills, enter the estimated year of landfill closure), the capacity (in metric tons) of the landfill, an indication of whether leachate recirculation is used during the reporting year and its typical frequency of use over the past 10 years (e.g., used several times a year for the past 10 years, used at least once a year for the past 10 years, used occasionally but not every year over the past 10 years, not used), an indication as to whether scales are present at the landfill, and the waste disposal quantity for each year of landfilling required to be included when using Equation HH-1 of this subpart (in metric tons, wet weight).
- (b) Method for estimating reporting year and historical waste disposal quantities, reason for its selection, and the range of years it is applied. For years when waste quantity data are determined using the methods in § 98.343(a)(3), report separately the quantity of waste determined using the methods in § 98.343(a)(3)(i) and the quantity of waste determined using the methods in § 98.343(a)(3)(ii). For historical waste disposal quantities that were not determined using the methods in § 98.343(a)(3), provide the population served by the landfill for each year the Equation HH-2 of this subpart is applied, if applicable, or, for open landfills using Equation HH-3 of this subpart, provide the value of landfill capacity (LFC) used in the calculation.
- (c) Waste composition for each year required for Equation HH-1 of this subpart, in percentage by weight, for each waste category listed in Table HH-1 to this subpart that is used in Equation HH-1 of this subpart to calculate the annual modeled CH<sub>4</sub> generation.
- (d) For each waste type used to calculate CH<sub>4</sub> generation using Equation HH-1 of this subpart, you must report:
  - (1) Degradable organic carbon (DOC) and fraction of DOC dissimilated (DOC<sub>f</sub>) values used in the calculations.



- (2) Decay rate (k) value used in the calculations.
- (e) Fraction of CH<sub>4</sub> in landfill gas (F), an indication of whether the fraction of CH<sub>4</sub> was determined based on measured values or the default value, and the methane correction factor (MCF) used in the calculations. If an MCF other than the default of 1 is used, provide an indication of whether active aeration of the waste in the landfill was conducted during the reporting year, a description of the aeration system, including aeration blower capacity, the fraction of the landfill containing waste affected by aeration, the total number of hours during the year the aeration blower was operated, and other factors used as a basis for the selected MCF value.
- (f) The surface area of the landfill containing waste (in square meters), identification of the type(s) of cover material used (as either organic cover, clay cover, sand cover, or other soil mixtures).
- (g) The modeled annual methane generation rate for the reporting year (metric tons CH<sub>4</sub>) calculated using Equation HH-1 of this subpart.
- (h) An indication of the applicability of part 60 or part 62 of this chapter requirements to the landfill (part 60, subparts WWW and XXX of this chapter, approved state plan implementing part 60, subparts Cc or Cf of this chapter, Federal plan as implemented at part 62, subparts GGG or OOO of this chapter, or not subject to part 60 or part 62 of this chapter municipal solid waste landfill rules), and if the landfill is subject to a part 60 or part 62 of this chapter municipal solid waste landfill rule, an indication of whether the landfill gas collection system is required under part 60 or part 62 of this chapter.
- (i) For landfills without gas collection systems, the annual methane emissions (i.e., the methane generation, adjusted for oxidation, calculated using Equation HH-5 of this subpart), reported in metric tons CH<sub>4</sub>, the oxidation fraction used in the calculation, and an indication of whether passive vents and/or passive flares (vents or flares that are not considered part of the gas collection system as defined in § 98.6) are present at this landfill.
- (j) For landfills with gas collection systems, you must report:
  - (1) Total volumetric flow of landfill gas collected for destruction for the reporting year (cubic feet at 520 °R or 60 degrees Fahrenheit and 1 atm).
  - (2) Annual average CH<sub>4</sub> concentration of landfill gas collected for destruction (percent by volume).
  - (3) Monthly average temperature and pressure for each month at which flow is measured for landfill gas collected for destruction, or statement that temperature and/or pressure is incorporated into internal calculations run by the monitoring equipment.
  - (4) An indication as to whether flow was measured on a wet or dry basis, an indication as to whether CH<sub>4</sub> concentration was measured on a wet or dry basis, and if required for Equation HH-4 of this subpart, monthly average moisture content for each month at which flow is measured for landfill gas collected for destruction.
  - (5) The number of gas collection systems at the landfill facility.
  - (6) For each gas collection system at the facility report:
    - (i) A unique name or ID number for the gas collection system.
    - (ii) A description of the gas collection system (manufacturer, capacity, and number of wells).

- (iii) The annual hours the gas collection system was operating normally. Do not include periods of shut down or poor operation, such as times when pressure, temperature, or other parameters indicative of operation are outside of normal variances, in the annual operating hours.
- (iv) The number of measurement locations associated with the gas collection system.
- (v) For each measurement location associated with the gas collection system, report:
  - (A) A unique name or ID number for the measurement location.
  - (B) Annual quantity of recovered CH<sub>4</sub> (metric tons CH<sub>4</sub>) calculated using equation HH-4 to § 98.343.
  - (C) An indication of whether destruction occurs at the landfill facility, off-site, or both for the measurement location.
  - (D) If destruction occurs at the landfill facility for the measurement location (in full or in part), also report the number of destruction devices associated with the measurement location that are located at the landfill facility and the information in paragraphs (j)(6)(v)(D)(1) through (6) of this section for each destruction device located at the landfill facility.
    - (1) A unique name or ID number for the destruction device.
    - (2) The type of destruction device (flare, a landfill gas to energy project (i.e., engine or turbine), off-site, or other (specify)).
    - (3) The destruction efficiency (decimal).
    - (4) The total annual hours where active gas flow was sent to the destruction device.
    - (5) The annual operating hours where active gas flow was sent to the destruction device and the destruction device was operating at its intended temperature or other parameter indicative of effective operation. For flares, times when there is no flame present must be excluded from the annual operating hours for the destruction device.
    - (6) The estimated fraction of the recovered CH<sub>4</sub> reported for the measurement location directed to the destruction device based on best available data or engineering judgement (decimal, must total to 1 for each measurement location).
- (7) The following information about the landfill.
  - (i) The surface area (square meters) and estimated waste depth (meters) for each area specified in table HH-3 to this subpart.
  - (ii) The estimated gas collection system efficiency for the landfill.
  - (iii) An indication of whether passive vents and/or passive flares (vents or flares that are not considered part of the gas collection system as defined in § 98.6) are present at the landfill.
- (8) Methane generation corrected for oxidation calculated using Equation HH-5 of this subpart, reported in metric tons CH<sub>4</sub>, and the oxidation fraction used in the calculation.
- (9) Methane generation (G<sub>CH<sub>4</sub></sub>) value used as an input to Equation HH-6 of this subpart. Specify whether the value is modeled (G<sub>CH<sub>4</sub></sub> from HH-1 of this subpart) or measured (R from Equation HH-4 of this subpart).

- (10) Methane generation corrected for oxidation calculated using Equation HH-7 of this subpart, reported in metric tons CH<sub>4</sub>, and the oxidation fraction used in the calculation.
- (11) Methane emissions calculated using Equation HH-6 of this subpart, reported in metric tons CH<sub>4</sub>, and the oxidation fraction used in the calculation.
- (12) Methane emissions calculated using Equation HH-8 of this subpart, reported in metric tons CH<sub>4</sub>, and the oxidation fraction used in the calculation.
- (13) Methane emissions for the landfill (i.e., the subpart HH total methane emissions). Choose the methane emissions from either Equation HH-6 or Equation HH-8 of this subpart that best represents the emissions from the landfill. If the quantity of recovered CH<sub>4</sub> from Equation HH-4 of this subpart is used as the value of G<sub>CH<sub>4</sub></sub> in Equation HH-6, use the methane emissions calculated using Equation HH-8 as the methane emissions for the landfill.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66472, Oct. 28, 2010; 78 FR 71970, Nov. 29, 2013; 81 FR 89266, Dec. 9, 2016; 89 FR 31940, Apr. 25, 2024]

### § 98.347 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the calibration records for all monitoring equipment, including the method or manufacturer's specification used for calibration. You must retain records of all measurements made to determine tare weights and working capacities by vehicle/container type if these are used to determine the annual waste quantities.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66473, Oct. 28, 2010]

### § 98.348 Definitions.

Except as specified in this section, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Construction and demolition (C&D) waste landfill** means a solid waste disposal facility subject to the requirements of part 257, subparts A or B of this chapter that receives construction and demolition waste and does not receive hazardous waste (defined in § 261.3 of this chapter) or industrial solid waste (defined in § 258.2 of this chapter) or municipal solid waste (as defined in § 98.6) other than residential lead-based paint waste. A C&D waste landfill typically receives any one or more of the following types of solid wastes: Roadwork material, excavated material, demolition waste, construction/renovation waste, and site clearance waste.

**Destruction device** means a flare, thermal oxidizer, boiler, turbine, internal combustion engine, or any other combustion unit used to destroy or oxidize methane contained in landfill gas.

**Final cover** means materials used at a landfill to meet final closure regulations of the competent federal, state, or local authority.

**Industrial waste landfill** means any landfill other than a municipal solid waste landfill, a RCRA Subtitle C hazardous waste landfill, or a TSCA hazardous waste landfill, in which industrial solid waste, such a RCRA Subtitle D wastes (nonhazardous industrial solid waste, defined in § 257.2 of this chapter), commercial solid wastes, or conditionally exempt small quantity generator wastes, is placed. An industrial waste landfill includes all disposal areas at the facility.

*Intermediate or interim cover* means the placement of material over waste in a landfill for a period of time prior to the disposal of additional waste and/or final closure as defined by state regulation, permit, guidance or written plan, or state accepted best management practice.

*Landfill capacity* means the maximum amount of solid waste a landfill can accept. For the purposes of this subpart, for landfills that have a permit, the *landfill capacity* can be determined in terms of volume or mass in the most recent permit issued by the state, local, or Tribal agency responsible for regulating the landfill, plus any in-place waste not accounted for in the most recent permit. If the owner or operator chooses to convert from volume to mass to determine its capacity, the calculation must include a site-specific density.

*Leachate recirculation* means the practice of taking the leachate collected from the landfill and reapplying it to the landfill by any of one of a variety of methods, including pre-wetting of the waste, direct discharge into the working face, spraying, infiltration ponds, vertical injection wells, horizontal gravity distribution systems, and pressure distribution systems.

*Passive vent* means a pipe or a system of pipes that allows landfill gas to flow naturally, without the use of a fan or similar mechanical draft equipment, to the surface of the landfill where an opening or pipe (vent) allows for the free flow of landfill gas to the atmosphere or to a passive vent flare without diffusion through the top layer of surface soil.

*Solid waste* has the meaning established by the Administrator pursuant to the Solid Waste Disposal Act (42 U.S.C.A. 6901 *et seq.*).

*Working capacity* means the maximum volume or mass of waste that is actually placed in the landfill from an individual or representative type of container (such as a tank, truck, or roll-off bin) used to convey wastes to the landfill, taking into account that the container may not be able to be 100 percent filled and/or 100 percent emptied for each load.

[75 FR 66473, Oct. 28, 2010, as amended at 78 FR 71970, Nov. 29, 2013; 81 FR 89266, Dec. 9, 2016]

**Table HH-1 to Subpart HH of Part 98—Emissions Factors, Oxidation Factors and Methods**

**TABLE HH-1 TO SUBPART HH OF PART 98—EMISSIONS FACTORS, OXIDATION FACTORS AND METHODS**

| Factor                                                                                                        | Default value | Units                       |
|---------------------------------------------------------------------------------------------------------------|---------------|-----------------------------|
| DOC and k values—Bulk waste option:                                                                           |               |                             |
| DOC (bulk waste) for disposal years prior to 2010                                                             | 0.20          | Weight fraction, wet basis. |
| DOC (bulk waste) for disposal years 2010 and later                                                            | 0.17          | Weight fraction, wet basis. |
| k (precipitation plus recirculated leachate <sup>a</sup> <20 inches/year) for disposal years prior to 2010    | 0.02          | yr <sup>-1</sup> .          |
| k (precipitation plus recirculated leachate <sup>a</sup> <20 inches/year) for disposal years 2010 and later   | 0.033         | yr <sup>-1</sup> .          |
| k (precipitation plus recirculated leachate <sup>a</sup> 20-40 inches/year) for disposal years prior to 2010  | 0.038         | yr <sup>-1</sup> .          |
| k (precipitation plus recirculated leachate <sup>a</sup> 20-40 inches/year) for disposal years 2010 and later | 0.067         | yr <sup>-1</sup> .          |
| k (precipitation plus recirculated leachate <sup>a</sup> >40 inches/year) for disposal years prior to 2010    | 0.057         | yr <sup>-1</sup> .          |
| k (precipitation plus recirculated leachate <sup>a</sup> >40 inches/year) for disposal years 2010 and later   | 0.098         | yr <sup>-1</sup> .          |
| DOC and k values—Modified bulk MSW option:                                                                    |               |                             |
| DOC (bulk MSW, excluding inerts and C&D waste) for disposal years prior to 2010                               | 0.31          | Weight fraction, wet basis. |
| DOC (bulk MSW, excluding inerts and C&D waste) for disposal years 2010 and later                              | 0.27          | Weight fraction, wet basis. |

<sup>a</sup> Recirculated leachate (in inches/year) is the total volume of leachate recirculated from company records or engineering estimates divided by the area of the portion of the landfill containing waste with appropriate unit conversions. Alternatively, landfills that use leachate recirculation can elect to use the k value of 0.098 rather than calculating the recirculated leachate rate.

<sup>b</sup> Use the lesser value when precipitation plus recirculated leachate is less than 20 inches/year. Use the greater value when precipitation plus recirculated leachate is greater than 40 inches/year. Use the average of the range of values when precipitation plus recirculated leachate is 20 to 40 inches/year (inclusive). Alternatively, landfills that use leachate recirculation can elect to use the greater value rather than calculating the recirculated leachate rate.

<sup>c</sup> Use the lesser value when the potential evapotranspiration rate exceeds the mean annual precipitation rate plus recirculated leachate. Use the greater value when the potential evapotranspiration rate does not exceed the mean annual precipitation rate plus recirculated leachate. Alternatively, landfills that use leachate recirculation can elect to use the greater value rather than assessing the potential evapotranspiration rate or recirculated leachate rate.

| Factor                                                                         | Default value               | Units                       |
|--------------------------------------------------------------------------------|-----------------------------|-----------------------------|
| DOC (inerts, e.g., glass, plastics, metal, concrete)                           | 0.00                        | Weight fraction, wet basis. |
| DOC (C&D waste)                                                                | 0.08                        | Weight fraction, wet basis. |
| k (bulk MSW, excluding inerts and C&D waste) for disposal years prior to 2010  | 0.02 to 0.057 <sup>b</sup>  | yr <sup>-1</sup> .          |
| k (bulk MSW, excluding inerts and C&D waste) for disposal years 2010 and later | 0.033 to 0.098 <sup>b</sup> | yr <sup>-1</sup> .          |
| k (inerts, e.g., glass, plastics, metal, concrete)                             | 0.00                        | yr <sup>-1</sup> .          |
| k (C&D waste)                                                                  | 0.02 to 0.04 <sup>b</sup>   | yr <sup>-1</sup> .          |
| DOC and k values—Waste composition option:                                     |                             |                             |
| DOC (food waste)                                                               | 0.15                        | Weight fraction, wet basis. |
| DOC (garden)                                                                   | 0.2                         | Weight fraction, wet basis. |
| DOC (paper)                                                                    | 0.4                         | Weight fraction, wet basis. |
| DOC (wood and straw)                                                           | 0.43                        | Weight fraction, wet basis. |
| DOC (textiles)                                                                 | 0.24                        | Weight fraction, wet basis. |
| DOC (diapers)                                                                  | 0.24                        | Weight fraction, wet basis. |
| DOC (sewage sludge)                                                            | 0.05                        | Weight fraction, wet basis. |
| DOC (inerts, e.g., glass, plastics, metal, cement)                             | 0.00                        | Weight fraction, wet basis. |
| DOC (Uncharacterized MSW)                                                      | 0.32                        | Weight fraction,            |

<sup>a</sup> Recirculated leachate (in inches/year) is the total volume of leachate recirculated from company records or engineering estimates divided by the area of the portion of the landfill containing waste with appropriate unit conversions. Alternatively, landfills that use leachate recirculation can elect to use the k value of 0.098 rather than calculating the recirculated leachate rate.

<sup>b</sup> Use the lesser value when precipitation plus recirculated leachate is less than 20 inches/year. Use the greater value when precipitation plus recirculated leachate is greater than 40 inches/year. Use the average of the range of values when precipitation plus recirculated leachate is 20 to 40 inches/year (inclusive). Alternatively, landfills that use leachate recirculation can elect to use the greater value rather than calculating the recirculated leachate rate.

<sup>c</sup> Use the lesser value when the potential evapotranspiration rate exceeds the mean annual precipitation rate plus recirculated leachate. Use the greater value when the potential evapotranspiration rate does not exceed the mean annual precipitation rate plus recirculated leachate. Alternatively, landfills that use leachate recirculation can elect to use the greater value rather than assessing the potential evapotranspiration rate or recirculated leachate rate.

| Factor                                             | Default value                  | Units              |
|----------------------------------------------------|--------------------------------|--------------------|
|                                                    |                                | wet basis.         |
| k (food waste)                                     | 0.06 to 0.185 <sup>c</sup>     | yr <sup>-1</sup> . |
| k (garden)                                         | 0.05 to 0.10 <sup>c</sup>      | yr <sup>-1</sup> . |
| k (paper)                                          | 0.04 to 0.06 <sup>c</sup>      | yr <sup>-1</sup> . |
| k (wood and straw)                                 | 0.02 to 0.03 <sup>c</sup>      | yr <sup>-1</sup> . |
| k (textiles)                                       | 0.04 to 0.06 <sup>c</sup>      | yr <sup>-1</sup> . |
| k (diapers)                                        | 0.05 to 0.10 <sup>c</sup>      | yr <sup>-1</sup> . |
| k (sewage sludge)                                  | 0.06 to 0.185 <sup>c</sup>     | yr <sup>-1</sup> . |
| k (inerts, e.g., glass, plastics, metal, concrete) | 0.00                           | yr <sup>-1</sup> . |
| k (uncharacterized MSW)                            | 0.033 to 0.098 <sup>b</sup>    | yr <sup>-1</sup> . |
| Other parameters—All MSW landfills:                |                                |                    |
| MCF                                                | 1                              |                    |
| DOC <sub>F</sub>                                   | 0.5                            |                    |
| F                                                  | 0.5                            |                    |
| OX                                                 | See table HH-4 to this subpart |                    |
| DE                                                 | 0.99                           |                    |

<sup>a</sup> Recirculated leachate (in inches/year) is the total volume of leachate recirculated from company records or engineering estimates divided by the area of the portion of the landfill containing waste with appropriate unit conversions. Alternatively, landfills that use leachate recirculation can elect to use the *k* value of 0.098 rather than calculating the recirculated leachate rate.

<sup>b</sup> Use the lesser value when precipitation plus recirculated leachate is less than 20 inches/year. Use the greater value when precipitation plus recirculated leachate is greater than 40 inches/year. Use the average of the range of values when precipitation plus recirculated leachate is 20 to 40 inches/year (inclusive). Alternatively, landfills that use leachate recirculation can elect to use the greater value rather than calculating the recirculated leachate rate.

<sup>c</sup> Use the lesser value when the potential evapotranspiration rate exceeds the mean annual precipitation rate plus recirculated leachate. Use the greater value when the potential evapotranspiration rate does not exceed the mean annual precipitation rate plus recirculated leachate. Alternatively, landfills that use leachate recirculation can elect to use the greater value rather than assessing the potential evapotranspiration rate or recirculated leachate rate.

[89 FR 31940, Apr. 25, 2024]

**Table HH-2 to Subpart HH of Part 98—U.S. Per Capita Waste Disposal Rates**

| Year | Waste per capita<br>ton/cap/yr |
|------|--------------------------------|
| 1950 | 0.63                           |
| 1951 | 0.63                           |
| 1952 | 0.63                           |
| 1953 | 0.63                           |
| 1954 | 0.63                           |
| 1955 | 0.63                           |
| 1956 | 0.63                           |
| 1957 | 0.63                           |
| 1958 | 0.63                           |
| 1959 | 0.63                           |
| 1960 | 0.63                           |
| 1961 | 0.64                           |
| 1962 | 0.64                           |
| 1963 | 0.65                           |
| 1964 | 0.65                           |
| 1965 | 0.66                           |
| 1966 | 0.66                           |
| 1967 | 0.67                           |
| 1968 | 0.68                           |
| 1969 | 0.68                           |
| 1970 | 0.69                           |
| 1971 | 0.69                           |
| 1972 | 0.70                           |
| 1973 | 0.71                           |
| 1974 | 0.71                           |
| 1975 | 0.72                           |
| 1976 | 0.73                           |
| 1977 | 0.73                           |
| 1978 | 0.74                           |
| 1979 | 0.75                           |
| 1980 | 0.75                           |
| 1981 | 0.76                           |
| 1982 | 0.77                           |
| 1983 | 0.77                           |
| 1984 | 0.78                           |
| 1985 | 0.79                           |



| Year                     | Waste per capita<br>ton/cap/yr |
|--------------------------|--------------------------------|
| 1986                     | 0.79                           |
| 1987                     | 0.80                           |
| 1988                     | 0.80                           |
| 1989                     | 0.83                           |
| 1990                     | 0.82                           |
| 1991                     | 0.76                           |
| 1992                     | 0.74                           |
| 1993                     | 0.76                           |
| 1994                     | 0.75                           |
| 1995                     | 0.70                           |
| 1996                     | 0.68                           |
| 1997                     | 0.69                           |
| 1998                     | 0.75                           |
| 1999                     | 0.75                           |
| 2000                     | 0.80                           |
| 2001                     | 0.91                           |
| 2002                     | 1.02                           |
| 2003                     | 1.02                           |
| 2004                     | 1.01                           |
| 2005                     | 0.98                           |
| 2006                     | 0.95                           |
| 2007                     | 0.95                           |
| 2008                     | 0.95                           |
| 2009 and all later years | 0.95                           |

[78 FR 71971, Nov. 29, 2013]

**Table HH-3 to Subpart HH of Part 98—Landfill Gas Collection Efficiencies**

**TABLE HH-3 TO SUBPART HH OF PART 98—LANDFILL GAS COLLECTION EFFICIENCIES**

| Description                                                                                                                                                                 | Term ID                                                                | Landfill gas collection efficiency |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------|
| A1: Area with no waste in-place                                                                                                                                             | Not applicable; do not use this area in the calculation.               |                                    |
| A2: Area without active gas collection, regardless of cover type                                                                                                            | CE2                                                                    | 0%.                                |
| A3: Area with daily soil cover and active gas collection                                                                                                                    | CE3                                                                    | 50%.                               |
| A4: Area with an intermediate soil cover, or a final soil cover not meeting the criteria for A5 below, and active gas collection                                            | CE4                                                                    | 65%.                               |
| A5: Area with a final soil cover of 3 feet or thicker of clay or final cover (as approved by the relevant agency) and/or geomembrane cover system and active gas collection | CE5                                                                    | 85%.                               |
| Area weighted average collection efficiency for landfills                                                                                                                   | $CE_{ave1} = (A2*CE2 + A3*CE3 + A4*CE4 + A5*CE5)/(A2 + A3 + A4 + A5).$ |                                    |

[89 FR 31941, Apr. 25, 2024]

**Table HH-4 to Subpart HH of Part 98—Landfill Methane Oxidation Fractions**

| Under these conditions:                                        | Use this landfill methane oxidation fraction: |
|----------------------------------------------------------------|-----------------------------------------------|
| I. FOR ALL REPORTING YEARS PRIOR TO THE 2013 REPORTING YEAR    |                                               |
| C1: For all landfills regardless of cover type or methane flux | 0.10                                          |
| II. FOR THE 2013 REPORTING YEAR AND ALL SUBSEQUENT YEARS       |                                               |

<sup>a</sup> Where a landfill is located in a state that does not have an intermediate or interim cover requirement, the landfill must have soil cover of 12 inches or greater in order to use an oxidation fraction of 0.25 or 0.35.

<sup>b</sup> Methane flux rate (in grams per square meter per day; g/m<sup>2</sup>/d) is the mass flow rate of methane per unit area at the bottom of the surface soil prior to any oxidation and is calculated as follows:

| Under these conditions:                                                                                                                                                                                                                                                                                                       | Use this landfill methane oxidation fraction: |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| C2: For landfills that have a geomembrane (synthetic) cover or other non-soil barrier meeting the definition of final cover with less than 12 inches of cover soil for greater than 50% of the landfill area containing waste                                                                                                 | 0.0                                           |
| C3: For landfills that do not meet the conditions in C2 above and for which you elect not to determine methane flux                                                                                                                                                                                                           | 0.10                                          |
| C4: For landfills that do not meet the conditions in C2 or C3 above and that do not have final cover, or intermediate or interim cover <sup>a</sup> for greater than 50% of the landfill area containing waste                                                                                                                | 0.10                                          |
| C5: For landfills that do not meet the conditions in C2 or C3 above and that have final cover, or intermediate or interim cover <sup>a</sup> for greater than 50% of the landfill area containing waste and for which the methane flux rate <sup>b</sup> is less than 10 grams per square meter per day (g/m <sup>2</sup> /d) | 0.35                                          |
| C6: For landfills that do not meet the conditions in C2 or C3 above and that have final cover or intermediate or interim cover <sup>a</sup> for greater than 50% of the landfill area containing waste and for which the methane flux rate <sup>b</sup> is 10 to 70 g/m <sup>2</sup> /d                                       | 0.25                                          |
| C7: For landfills that do not meet the conditions in C2 or C3 above and that have final cover or intermediate or interim cover <sup>a</sup> for greater than 50% of the landfill area containing waste and for which the methane flux rate <sup>b</sup> is greater than 70 g/m <sup>2</sup> /d                                | 0.10                                          |

<sup>a</sup> Where a landfill is located in a state that does not have an intermediate or interim cover requirement, the landfill must have soil cover of 12 inches or greater in order to use an oxidation fraction of 0.25 or 0.35.

<sup>b</sup> Methane flux rate (in grams per square meter per day; g/m<sup>2</sup>/d) is the mass flow rate of methane per unit area at the bottom of the surface soil prior to any oxidation and is calculated as follows:

For equation HH-5 to § 98.343, or for equation TT-6 to § 98.463,

$$MF = K \times G_{CH_4} / S_{Area}$$

For equation HH-6 to § 98.343,

$$MF = K \times \left( G_{CH_4} - \sum_{n=1}^N R_n \right) / S_{Area}$$

For equation HH-7 to § 98.343,

$$MF = K \times \left( \frac{1}{CE} \sum_{C=1}^C \left[ \frac{\sum_{X=1}^X R_{X,C}}{f_{Rec,C}} \right] \right) / Sarea$$

For equation HH-8 to § 98.343,

$$MF = K \times \left( \frac{1}{CE} \sum_{C=1}^C \left[ \frac{\sum_{X=1}^X R_{X,C}}{f_{Rec,C}} \right] - \sum_{n=1}^N R_n \right) / Sarea$$

Where:

MF = Methane flux rate from the landfill in the reporting year (grams per square meter per day, g/m<sup>2</sup>/d).

K = unit conversion factor = 10<sup>6</sup>/365 (g/metric ton per days/year) or 10<sup>6</sup>/366 for a leap year.

Sarea = The surface area of the landfill containing waste at the beginning of the reporting year (square meters, m<sup>2</sup>).

G<sub>CH4</sub> = Modeled methane generation rate in reporting year from equation HH-1 to § 98.343 or equation TT-1 to § 98.463, as applicable, except for application with equation HH-6 to § 98.343 (metric tons CH<sub>4</sub>). For application with equation HH-6 to § 98.343, the greater of the modeled methane generation rate in reporting year from equation HH-1 to § 98.343 or equation TT-1 to § 98.463, as applicable, and the quantity of recovered CH<sub>4</sub> from equation HH-4 to § 98.343 (metric tons CH<sub>4</sub>).

CE = Collection efficiency estimated at landfill, taking into account system coverage, operation, measurement practices, and cover system materials from table HH-3 to this subpart. If area by soil cover type information is not available, use applicable default value for CE4 in table HH-3 to this subpart for all areas under active influence of the collection system.

C = Number of landfill gas collection systems operated at the landfill.

X = Number of landfill gas measurement locations associated with landfill gas collection system "c".

N = Number of landfill gas measurement locations (associated with a destruction device or gas sent off-site). If a single monitoring location is used to monitor volumetric flow and CH<sub>4</sub> concentration of the recovered gas sent to one or multiple destruction devices, then N = 1. Note that  $N = \sum_{C=1}^C [\sum_{X=1}^X 1]$ .

R<sub>x,c</sub> = Quantity of recovered CH<sub>4</sub> from equation HH-4 to § 98.343 for the x<sup>th</sup> measurement location for landfill gas collection system "c" (metric tons CH<sub>4</sub>).

R<sub>n</sub> = Quantity of recovered CH<sub>4</sub> from equation HH-4 to § 98.343 for the n<sup>th</sup> measurement location (metric tons CH<sub>4</sub>).

f<sub>Rec,c</sub> = Fraction of hours the landfill gas collection system "c" was operating normally (annual operating hours/8,760 hours per year or annual operating hours/8,784 hours per year for a leap year). Do not include periods of shutdown or poor operation, such as times when pressure, temperature, or other parameters indicative of operation are outside of normal variances, in the annual operating hours.

[78 FR 71971, Nov. 29, 2013, as amended at 81 FR 89266, Dec. 9, 2016; 89 FR 31941, Apr. 25, 2024]

## Subpart II—Industrial Wastewater Treatment

**Source:** 75 FR 39767, July 12, 2010, unless otherwise noted.

### § 98.350 Definition of source category.

- (a) This source category consists of anaerobic processes used to treat industrial wastewater and industrial wastewater treatment sludge at facilities that perform the operations listed in this paragraph.
  - (1) Pulp and paper manufacturing.
  - (2) Food processing.
  - (3) Ethanol production.
  - (4) Petroleum refining.
- (b) An *anaerobic process* is a procedure in which organic matter in wastewater, wastewater treatment sludge, or other material is degraded by micro-organisms in the absence of oxygen, resulting in the generation of CO<sub>2</sub> and CH<sub>4</sub>. This source category consists of the following: anaerobic reactors, anaerobic lagoons, anaerobic sludge digesters, and biogas destruction devices (for example, burners, boilers, turbines, flares, or other devices).
  - (1) An *anaerobic reactor* is an enclosed vessel used for anaerobic wastewater treatment (e.g., upflow anaerobic sludge blanket, fixed film).
  - (2) An *anaerobic sludge digester* is an enclosed vessel in which wastewater treatment sludge is degraded anaerobically.
  - (3) An *anaerobic lagoon* is a lined or unlined earthen basin used for wastewater treatment, in which oxygen is absent throughout the depth of the basin, except for a shallow surface zone. Anaerobic lagoons are not equipped with surface aerators. Anaerobic lagoons are classified as deep (depth more than 2 meters) or shallow (depth less than 2 meters).
- (c) This source category does not include municipal wastewater treatment plants or separate treatment of sanitary wastewater at industrial sites.

[75 FR 39767, July 12, 2010, as amended at 76 FR 73903, Nov. 29, 2011]

### § 98.351 Reporting threshold.

You must report GHG emissions under this subpart if your facility meets all of the conditions under paragraphs (a) or (b) of this section:

- (a) *Petroleum refineries and pulp and paper manufacturing.*
  - (1) The facility is subject to reporting under subpart Y of this part (Petroleum Refineries) or subpart AA of this part (Pulp and Paper Manufacturing).
  - (2) The facility meets the requirements of either § 98.2(a)(1) or (2).
  - (3) The facility operates an anaerobic process to treat industrial wastewater and/or industrial wastewater treatment sludge.

(b) **Ethanol production and food processing facilities.**

- (1) The facility performs an ethanol production or food processing operation, as defined in § 98.358 of this subpart.
- (2) The facility meets the requirements of § 98.2(a)(2).
- (3) The facility operates an anaerobic process to treat industrial wastewater and/or industrial wastewater treatment sludge.

**§ 98.352 GHGs to report.**

- (a) You must report CH<sub>4</sub> generation, CH<sub>4</sub> emissions, and CH<sub>4</sub> recovered from treatment of industrial wastewater at each anaerobic lagoon and anaerobic reactor.
- (b) You must report CH<sub>4</sub> emissions and CH<sub>4</sub> recovered from each anaerobic sludge digester.
- (c) You must report CH<sub>4</sub> emissions and CH<sub>4</sub> destruction resulting from each biogas collection and biogas destruction device.
- (d) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit associated with the biogas destruction device, if present, by following the requirements of subpart C of this part.

[75 FR 39767, July 12, 2010, as amended at 76 FR 73903, Nov. 29, 2011]

**§ 98.353 Calculating GHG emissions.**

- (a) For each anaerobic reactor and anaerobic lagoon, estimate the annual mass of CH<sub>4</sub> generated according to the applicable requirements in paragraphs (a)(1) through (a)(2) of this section.
  - (1) If you measure the concentration of organic material entering the anaerobic reactors or anaerobic lagoon using methods for the determination of chemical oxygen demand (COD), then estimate annual mass of CH<sub>4</sub> generated using Equation II-1 of this section.

$$CH_4G_n = \sum_{w=1}^{52} |Flow_w \cdot COD_w \cdot B_0 \cdot MCF \cdot 0.001| \quad (\text{Eq. II-1})$$

Where:

CH<sub>4</sub>G<sub>n</sub> = Annual mass CH<sub>4</sub> generated from the nth anaerobic wastewater treatment process (metric tons).

n = Index for processes at the facility, used in Equation II-7.

w = Index for weekly measurement period.

Flow<sub>w</sub> = Volume of wastewater sent to an anaerobic wastewater treatment process in week w (m<sup>3</sup>/week), measured as specified in § 98.354(d).

COD<sub>w</sub> = Average weekly concentration of chemical oxygen demand of wastewater entering an anaerobic wastewater treatment process (for week w)(kg/m<sup>3</sup>), measured as specified in § 98.354(b) and (c).

$B_0$  = Maximum  $\text{CH}_4$  producing potential of wastewater (kg  $\text{CH}_4$ /kg COD), use the value 0.25.

MCF =  $\text{CH}_4$  conversion factor, based on relevant values in Table II-1 of this subpart.

0.001 = Conversion factor from kg to metric tons.

- (2) If you measure the concentration of organic material entering an anaerobic reactor or anaerobic lagoon using methods for the determination of 5-day biochemical oxygen demand ( $\text{BOD}_5$ ), then estimate annual mass of  $\text{CH}_4$  generated using Equation II-2 of this section.

$$\text{CH}_4 G_n = \sum_{w=1}^{52} [\text{Flow}_w * \text{BOD}_{5,w} * B_o * \text{MCF} * 0.001] \quad (\text{Eq. II-2})$$

Where:

$\text{CH}_4 G_n$  = Annual mass of  $\text{CH}_4$  generated from the anaerobic wastewater treatment process (metric tons).

$n$  = Index for processes at the facility, used in Equation II-7.

$w$  = Index for weekly measurement period.

$\text{Flow}_w$  = Volume of wastewater sent to an anaerobic wastewater treatment process in week  $w$  ( $\text{m}^3/\text{week}$ ), measured as specified in § 98.354(d).

$\text{BOD}_{5,w}$  = Average weekly concentration of 5-day biochemical oxygen demand of wastewater entering an anaerobic wastewater treatment process for week  $w$  ( $\text{kg}/\text{m}^3$ ), measured as specified in § 98.354(b) and (c).

$B_0$  = Maximum  $\text{CH}_4$  producing potential of wastewater (kg  $\text{CH}_4$ /kg  $\text{BOD}_5$ ), use the value 0.6.

MCF =  $\text{CH}_4$  conversion factor, based on relevant values in Table II-1 to this subpart.

0.001 = Conversion factor from kg to metric tons.

- (b) For each anaerobic reactor and anaerobic lagoon from which biogas is not recovered, estimate annual  $\text{CH}_4$  emissions using Equation II-3 of this section.

$$\text{CH}_4 E_n = \text{CH}_4 G_n \quad (\text{Eq. II-3})$$

Where:

$\text{CH}_4 E_n$  = Annual mass of  $\text{CH}_4$  emissions from the wastewater treatment process  $n$  from which biogas is not recovered (metric tons).

$\text{CH}_4 G_n$  = Annual mass of  $\text{CH}_4$  generated from the wastewater treatment process  $n$ , as calculated in Equation II-1 or II-2 of this section (metric tons).

(c) For each anaerobic sludge digester, anaerobic reactor, or anaerobic lagoon from which some biogas is recovered, estimate the annual mass of CH<sub>4</sub> recovered according to the requirements in paragraphs (c)(1) and (c)(2) of this section. To estimate the annual mass of CH<sub>4</sub> recovered, you must continuously monitor biogas flow rate and determine the volume of biogas each week and the cumulative volume of biogas each year that is collected and routed to a destruction device as specified in § 98.354(h). If the gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content, you must determine these parameters as specified in paragraph (c)(2)(ii) of this section.

(1) If you continuously monitor CH<sub>4</sub> concentration (and if necessary, temperature, pressure, and moisture content required as specified in § 98.354(f)) of the biogas that is collected and routed to a destruction device using a monitoring meter specifically for CH<sub>4</sub> gas, as specified in § 98.354(g), you must use this monitoring system and calculate the quantity of CH<sub>4</sub> recovered for destruction using Equation II-4 of this section. A fully integrated system that directly reports CH<sub>4</sub> quantity requires only the summing of results of all monitoring periods for a given year.

$$R_n = \sum_{m=1}^M \left[ (V)_m \cdot (K_{MC})_m \cdot \frac{(C_{CH_4})_m}{100\%} \cdot 0.0423 \cdot \frac{520^\circ R}{(T)_m} \cdot \frac{(P)_m}{1 \text{ atm}} \cdot \frac{0.454}{1,000} \right] \quad (\text{Eq. II-4})$$

Where:

$R_n$  = Annual quantity of CH<sub>4</sub> recovered from the nth anaerobic reactor, sludge digester, or lagoon (metric tons CH<sub>4</sub>/yr)

$n$  = Index for processes at the facility, used in Equation II-7.

$M$  = Total number of measurement periods in a year. Use  $M = 365$  ( $M = 366$  for leap years) for daily averaging of continuous monitoring, as provided in paragraph (c)(1) of this section. Use  $M = 52$  for weekly sampling, as provided in paragraph (c)(2) of this section.

$m$  = Index for measurement period.

$V_m$  = Cumulative volumetric flow for the measurement period in actual cubic feet (acf). If no biogas was recovered during a monitoring period, use zero.

$(K_{MC})_m$  = Moisture correction term for the measurement period, volumetric basis.

= 1 when  $(V)_m$  and  $(C_{CH_4})_m$  are measured on a dry basis or if both are measured on a wet basis.

=  $1 - (f_{H_2O})_m$  when  $(V)_m$  is measured on a wet basis and  $(C_{CH_4})_m$  is measured on a dry basis.

=  $1/[1 - (f_{H_2O})_m]$  when  $(V)_m$  is measured on a dry basis and  $(C_{CH_4})_m$  is measured on a wet basis.

$(f_{H_2O})_m$  = Average moisture content of biogas during the measurement period, volumetric basis, (cubic feet water per cubic feet biogas).

$(C_{CH_4})_m$  = Average CH<sub>4</sub> concentration of biogas during the measurement period, (volume %).



0.0423 = Density of CH<sub>4</sub> lb/cf at 520 °R or 60 °F and 1 atm.

520 °R = 520 degrees Rankine.

T<sub>m</sub> = Average temperature at which flow is measured for the measurement period (°R). If the flow rate meter automatically corrects for temperature to 520° R, replace "520° R/T<sub>m</sub>" with "1".

P<sub>m</sub> = Average pressure at which flow is measured for the measurement period (atm). If the flow rate meter automatically corrects for pressure to 1 atm, replace "P<sub>m</sub>/1" with "1".

0.454/1,000 = Conversion factor (metric ton/lb).

- (2) If you do not continuously monitor CH<sub>4</sub> concentration according to paragraph (c)(1) of this section, you must determine the CH<sub>4</sub> concentration, temperature, pressure, and, if necessary, moisture content of the biogas that is collected and routed to a destruction device according to the requirements in paragraphs (c)(2)(i) through (c)(2)(ii) of this section and calculate the quantity of CH<sub>4</sub> recovered for destruction using Equation II-4 of this section.
  - (i) Determine the CH<sub>4</sub> concentration in the biogas that is collected and routed to a destruction device in a location near or representative of the location of the gas flow meter at least once each calendar week; if only one measurement is made each calendar week, there must be least three days between measurements. For a given calendar week, you are not required to determine CH<sub>4</sub> concentration if the cumulative volume of biogas for that calendar week, determined as specified in paragraph (c) of this section, is zero.
  - (ii) If the gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content:
    - (A) Determine the temperature and pressure in the biogas that is collected and routed to a destruction device in a location near or representative of the location of the gas flow meter at least once each calendar week; if only one measurement is made each calendar week, there must be at least three days between measurements.
    - (B) If the CH<sub>4</sub> concentration is determined on a dry basis and biogas flow is determined on a wet basis, or CH<sub>4</sub> concentration is determined on a wet basis and biogas flow is determined on a dry basis, and the flow meter does not automatically correct for moisture content, determine the moisture content in the biogas that is collected and routed to a destruction device in a location near or representative of the location of the gas flow meter at least once each calendar week that the cumulative biogas flow measured as specified in § 98.354(h) is greater than zero; if only one measurement is made each calendar week, there must be at least three days between measurements.
- (d) For each anaerobic sludge digester, anaerobic reactor, or anaerobic lagoon from which some quantity of biogas is recovered, you must estimate both the annual mass of CH<sub>4</sub> that is generated, but not recovered, according to paragraph (d)(1) of this section and the annual mass of CH<sub>4</sub> emitted according to paragraph (d)(2) of this section.
  - (1) Estimate the annual mass of CH<sub>4</sub> that is generated, but not recovered, using Equation II-5 of this section.

$$CH_4L_n = R_n \cdot \left( \frac{1}{CE} - 1 \right) \quad (\text{Eq. II-5})$$

Where:

$CH_4L_n$  = Leakage at the anaerobic process n (metric tons  $CH_4$ ).

n = Index for processes at the facility, used in Equation II-7.

$R_n$  = Annual quantity of  $CH_4$  recovered from the nth anaerobic reactor, anaerobic lagoon, or anaerobic sludge digester, as calculated in Equation II-4 of this section (metric tons  $CH_4$ ).

CE =  $CH_4$  collection efficiency of anaerobic process n, as specified in Table II-2 of this subpart (decimal).

- (2) For each anaerobic sludge digester, anaerobic reactor, or anaerobic lagoon from which some quantity of biogas is recovered, estimate the annual mass of  $CH_4$  emitted using Equation II-6 of this section.

$$CH_4E_n = CH_4L_n + R_n (1 - [(DE_1 * f_{Dest\_1}) + (DE_2 * f_{Dest\_2})]) \quad (\text{Eq. II-6})$$

Where:

$CH_4E_n$  = Annual quantity of  $CH_4$  emitted from the process n from which biogas is recovered (metric tons).

n = Index for processes at the facility, used in Equation II-7.

$CH_4L_n$  = Leakage at the anaerobic process n, as calculated in Equation II-5 of this section (metric tons  $CH_4$ ).

$R_n$  = Annual quantity of  $CH_4$  recovered from the nth anaerobic reactor or anaerobic sludge digester, as calculated in Equation II-4 of this section (metric tons  $CH_4$ ).

$DE_1$  = Primary destruction device  $CH_4$  destruction efficiency (lesser of manufacturer's specified destruction efficiency and 0.99). If the biogas is transported off-site for destruction, use  $DE = 1$ .

$f_{Dest\_1}$  = Fraction of hours the primary destruction device was operating calculated as the annual hours when the destruction device was operating divided by the annual operating hours of the biogas recovery system. If the biogas is transported off-site for destruction, use  $f_{Dest} = 1$ .

$DE_2$  = Back-up destruction device  $CH_4$  destruction efficiency (lesser of manufacturer's specified destruction efficiency and 0.99).

$f_{Dest\_2}$  = Fraction of hours the back-up destruction device was operating calculated as the annual hours when the destruction device was operating divided by the annual operating hours of the biogas recovery system.

- (e) Estimate the total mass of  $CH_4$  emitted from all anaerobic processes from which biogas is not recovered (calculated in Eq. II-3) and all anaerobic processes from which some biogas is recovered (calculated in Equation II-6) using Equation II-7 of this section.

$$CH_4E_T = \sum_{n=1}^j CH_4E_n \quad (\text{Eq. II-7})$$

Where:

$CH_4E_T$  = Annual mass  $CH_4$  emitted from all anaerobic processes at the facility (metric tons).

$n$  = Index for processes at the facility.

$CH_4E_n$  = Annual mass of  $CH_4$  emissions from process  $n$  (metric tons).

$j$  = Total number of processes from which methane is emitted.

[75 FR 39767, July 12, 2010, as amended at 76 FR 73903, Nov. 29, 2011; 78 FR 71972, Nov. 29, 2013]

### § 98.354 Monitoring and QA/QC requirements.

- (a) For calendar year 2011 monitoring, the facility may submit a request to the Administrator to use one or more best available monitoring methods as listed in § 98.3(d)(1)(i) through (iv). The request must be submitted no later than October 12, 2010 and must contain the information in § 98.3(d)(2)(ii). To obtain approval, the request must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by January 1, 2011. The use of best available monitoring methods will not be approved beyond December 31, 2011.
- (b) You must determine the concentration of organic material in wastewater treated anaerobically using analytical methods for COD or  $BOD_5$  specified in 40 CFR 136.3 Table 1B. For the purpose of determining concentrations of wastewater influent to the anaerobic wastewater treatment process, samples may be diluted to the concentration range of the approved method, but the calculated concentration of the undiluted wastewater must be used for calculations and reporting required by this subpart.
- (c) You must collect samples representing wastewater influent to the anaerobic wastewater treatment process, following all preliminary and primary treatment steps (e.g., after grit removal, primary clarification, oil-water separation, dissolved air flotation, or similar solids and oil separation processes). You must collect and analyze samples for COD or  $BOD_5$  concentration at least once each calendar week that the anaerobic wastewater treatment process is operating; if only one measurement is made each calendar week, there must be at least three days between measurements. You must collect a sample that represents the average COD or  $BOD_5$  concentration of the waste stream over a 24-hour sampling period. You must collect a minimum of four sample aliquots per 24-hour period and composite the aliquots for analysis. Collect a flow-proportional composite sample (either constant time interval between samples with sample volume proportional to stream flow, or constant sample volume with time interval between samples proportional to stream flow). Follow sampling procedures and techniques presented in Chapter 5, Sampling, of the "NPDES Compliance Inspection Manual," (incorporated by reference, see § 98.7) or Section 7.1.3, Sample Collection Methods, of the "U.S. EPA NPDES Permit Writers' Manual," (incorporated by reference, see § 98.7).
- (d) You must measure the flowrate of wastewater entering anaerobic wastewater treatment process at least once each calendar week that the process is operating; if only one measurement is made each calendar week, there must be at least three days between measurements. You must measure the flowrate for the

24-hour period for which you collect samples analyzed for COD or BOD<sub>5</sub> concentration. The flow measurement location must correspond to the location used to collect samples analyzed for COD or BOD<sub>5</sub> concentration. You must measure the flowrate using one of the methods specified in paragraphs (d)(1) through (d)(5) of this section or as specified by the manufacturer.

- (1) ASME MFC-3M-2004 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, see § 98.7).
  - (2) ASME MFC-5M-1985 (Reaffirmed 1994) Measurement of Liquid Flow in Closed Conduits Using Transit-Time Ultrasonic Flowmeters (incorporated by reference, see § 98.7).
  - (3) ASME MFC-16-2007 Measurement of Liquid Flow in Closed Conduits with Electromagnetic Flowmeters (incorporated by reference, see § 98.7).
  - (4) ASTM D1941-91 (Reapproved 2007) Standard Test Method for Open Channel Flow Measurement of Water with the Parshall Flume, approved June 15, 2007, (incorporated by reference, see § 98.7).
  - (5) ASTM D5614-94 (Reapproved 2008) Standard Test Method for Open Channel Flow Measurement of Water with Broad-Crested Weirs, approved October 1, 2008, (incorporated by reference, see § 98.7).
- (e) All wastewater flow measurement devices must be calibrated prior to the first year of reporting and recalibrated either biennially (every 2 years) or at the minimum frequency specified by the manufacturer. Wastewater flow measurement devices must be calibrated using the procedures specified by the device manufacturer.
- (f) For each anaerobic process (such as anaerobic reactor, sludge digester, or lagoon) from which biogas is recovered, you must make the measurements or determinations specified in paragraphs (f)(1) through (f)(3) of this section.
- (1) You must continuously measure the biogas flow rate as specified in paragraph (h) of this section and determine the cumulative volume of biogas recovered.
  - (2) You must determine the CH<sub>4</sub> concentration of the recovered biogas as specified in paragraph (g) of this section at a location near or representative of the location of the gas flow meter. You must determine CH<sub>4</sub> concentration either continuously or intermittently. If you determine the concentration intermittently, you must determine the concentration at least once each calendar week that the cumulative biogas flow measured as specified in paragraph (h) of this section is greater than zero, with at least three days between measurements.
  - (3) As specified in § 98.353(c) and paragraph (h) of this section, you must determine temperature, pressure, and moisture content as necessary to accurately determine the biogas flow rate and CH<sub>4</sub> concentration. You must determine temperature and pressure if the gas flow meter or gas composition monitor do not automatically correct for temperature or pressure. You must measure moisture content of the recovered biogas if the biogas flow rate is measured on a wet basis and the CH<sub>4</sub> concentration is measured on a dry basis. You must also measure the moisture content of the recovered biogas if the biogas flow rate is measured on a dry basis and the CH<sub>4</sub> concentration is measured on a wet basis.
- (g) For each anaerobic process (such as an anaerobic reactor, sludge digester, or lagoon) from which biogas is recovered, operate, maintain, and calibrate a gas composition monitor capable of measuring the concentration of CH<sub>4</sub> in the recovered biogas using one of the methods specified in paragraphs (g)(1) through (g)(6) of this section or as specified by the manufacturer.

- (1) Method 18 at 40 CFR part 60, appendix A-6.
- (2) ASTM D1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography (incorporated by reference, see § 98.7).
- (3) ASTM D1946-90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference, see § 98.7).
- (4) GPA Standard 2261-00, Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography (incorporated by reference, see § 98.7).
- (5) ASTM UOP539-97 Refinery Gas Analysis by Gas Chromatography (incorporated by reference, see § 98.7).
- (6) As an alternative to the gas chromatography methods provided in paragraphs (g)(1) through (g)(5) of this section, you may use total gaseous organic concentration analyzers and calculate the CH<sub>4</sub> concentration following the requirements in paragraphs (g)(6)(i) through (g)(6)(iii) of this section.
  - (i) Use Method 25A or 25B at 40 CFR part 60, appendix A-7 to determine total gaseous organic concentration. You must calibrate the instrument with CH<sub>4</sub> and determine the total gaseous organic concentration as carbon (or as CH<sub>4</sub>; K = 1 in Equation 25A-1 of Method 25A at 40 CFR part 60, appendix A-7).
  - (ii) Determine a non-methane organic carbon correction factor at the routine sampling location no less frequently than once a reporting year following the requirements in paragraphs (g)(6)(ii)(A) through (g)(6)(ii)(C) of this section.
    - (A) Take a minimum of three grab samples of the biogas with a minimum of 20 minutes between samples and determine the methane composition of the biogas using one of the methods specified in paragraphs (g)(1) through (g)(5) of this section.
    - (B) As soon as practical after each grab sample is collected and prior to the collection of a subsequent grab sample, determine the total gaseous organic concentration of the biogas using either Method 25A or 25B at 40 CFR part 60, appendix A-7 as specified in paragraph (g)(6)(i) of this section.
    - (C) Determine the arithmetic average methane concentration and the arithmetic average total gaseous organic concentration of the samples analyzed according to paragraphs (g)(6)(ii)(A) and (g)(6)(ii)(B) of this section, respectively, and calculate the non-methane organic carbon correction factor as the ratio of the average methane concentration to the average total gaseous organic concentration. If the ratio exceeds 1, use 1 for the non-methane organic carbon correction factor.
  - (iii) Calculate the CH<sub>4</sub> concentration as specified in Equation II-8 of this section.

$$C_{CH_4} = f_{NMOC} \times C_{TGO} \quad (\text{Eq. II-8})$$

Where:

$C_{CH_4}$  = Methane (CH<sub>4</sub>) concentration in the biogas (volume %) for use in Equation II-4 of this subpart.

$f_{NMOC}$  = Non-methane organic carbon correction factor from the most recent determination of the non-methane organic carbon correction factor as specified in paragraph (g)(6)(ii) of this section (unitless).

$C_{TGO C}$  = Total gaseous organic carbon concentration measured using Method 25A or 25B at 40 CFR part 60, appendix A-7 during routine monitoring of the biogas (volume %).

- (h) For each anaerobic process (such as an anaerobic reactor, sludge digester, or lagoon) from which biogas is recovered, install, operate, maintain, and calibrate a gas flow meter capable of continuously measuring the volumetric flow rate of the recovered biogas using one of the methods specified in paragraphs (h)(1) through (h)(8) of this section or as specified by the manufacturer. Recalibrate each gas flow meter either biennially (every 2 years) or at the minimum frequency specified by the manufacturer. Except as provided in § 98.353(c)(2)(iii), each gas flow meter must be capable of correcting for the temperature and pressure and, if necessary, moisture content.
  - (1) ASME MFC-3M-2004, Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, see § 98.7).
  - (2) ASME MFC-4M-1986 (Reaffirmed 1997), Measurement of Gas Flow by Turbine Meters (incorporated by reference, see § 98.7).
  - (3) ASME MFC-6M-1998, Measurement of Fluid Flow in Pipes Using Vortex Flowmeters (incorporated by reference, see § 98.7).
  - (4) ASME MFC-7M-1987 (Reaffirmed 1992), Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles (incorporated by reference, see § 98.7).
  - (5) ASME MFC-11M-2006 Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters (incorporated by reference, see § 98.7). The mass flow must be corrected to volumetric flow based on the measured temperature, pressure, and biogas composition.
  - (6) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters (incorporated by reference, see § 98.7).
  - (7) ASME MFC-18M-2001 Measurement of Fluid Flow using Variable Area Meters (incorporated by reference, see § 98.7).
  - (8) Method 2A or 2D at 40 CFR part 60, appendix A-1.
- (i) All temperature, pressure, and, moisture content monitors required as specified in paragraph (f) of this section must be calibrated using the procedures and frequencies where specified by the device manufacturer, if not specified use an industry accepted or industry standard practice.
- (j) All equipment (temperature, pressure, and moisture content monitors and gas flow meters and gas composition monitors) must be maintained as specified by the manufacturer.
- (k) If applicable, the owner or operator must document the procedures used to ensure the accuracy of measurements of COD or BOD<sub>5</sub> concentration, wastewater flow rate, biogas flow rate, biogas composition, temperature, pressure, and moisture content. These procedures include, but are not limited to, calibration of gas flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be documented.

[75 FR 39767, July 12, 2010, as amended at 76 FR 73904, Nov. 29, 2011]

### § 98.355 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required sample is not taken), a substitute data value for the missing parameter must be used in the calculations, according to the following requirements in paragraphs (a) through (c) of this section:

- (a) For each missing weekly value of COD or BOD<sub>5</sub> or wastewater flow entering an anaerobic wastewater treatment process, the substitute data value must be the arithmetic average of the quality-assured values of those parameters for the week immediately preceding and the week immediately following the missing data incident.
- (b) For each missing value of the CH<sub>4</sub> content or biogas flow rates, the substitute data value must be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident.
- (c) If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value must be the first quality-assured value obtained after the missing data period. If, for a particular parameter, the “after” value is not obtained by the end of the reporting year, you may use the last quality-assured value obtained “before” the missing data period for the missing data substitution. You must document and keep records of the procedures you use for all such estimates.

[75 FR 39767, July 12, 2010, as amended at 76 FR 73905, Nov. 29, 2011]

### § 98.356 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information for each wastewater treatment system.

- (a) Identify the anaerobic processes used in the industrial wastewater treatment system to treat industrial wastewater and industrial wastewater treatment sludge, provide a unique identifier for each anaerobic process, indicate the average depth in meters of each anaerobic lagoon, and indicate whether biogas generated by each anaerobic process is recovered. Provide a description or diagram of the industrial wastewater treatment system, identifying the processes used, indicating how the processes are related to each other, and providing a unique identifier for each anaerobic process. Each anaerobic process must be identified as one of the following:
  - (1) Anaerobic reactor.
  - (2) Anaerobic deep lagoon (depth more than 2 meters).
  - (3) Anaerobic shallow lagoon (depth less than 2 meters).
  - (4) Anaerobic sludge digester.
- (b) For each anaerobic wastewater treatment process (reactor, deep lagoon, or shallow lagoon) you must report:
  - (1) Weekly average COD or BOD<sub>5</sub> concentration of wastewater entering each anaerobic wastewater treatment process, for each week the anaerobic process was operated.
  - (2) Volume of wastewater entering each anaerobic wastewater treatment process for each week the anaerobic process was operated.

- (3) Maximum CH<sub>4</sub> production potential (B<sub>0</sub>) used as an input to Equation II-1 or II-2 of this subpart, from Table II-1 to this subpart.
- (4) Methane conversion factor (MCF) used as an input to Equation II-1 or II-2 of this subpart, from Table II-1 to this subpart.
- (5) Annual mass of CH<sub>4</sub> generated by each anaerobic wastewater treatment process, calculated using Equation II-1 or II-2 of this subpart.
- (6) If the facility performs an ethanol production processing operation as defined in § 98.358, you must indicate if the facility uses a wet milling process or a dry milling process.
- (c) For each anaerobic wastewater treatment process from which biogas is not recovered, you must report the annual CH<sub>4</sub> emissions, calculated using Equation II-3 of this subpart.
- (d) For each anaerobic wastewater treatment process and anaerobic sludge digester from which some biogas is recovered, you must report:
  - (1) Annual quantity of CH<sub>4</sub> recovered from the anaerobic process calculated using Equation II-4 of this subpart.
  - (2) Total weekly volumetric biogas flow for each week (up to 52 weeks/year) that biogas is collected for destruction.
  - (3) Weekly average CH<sub>4</sub> concentration for each week that biogas is collected for destruction.
  - (4) Weekly average biogas temperature for each week at which flow is measured for biogas collected for destruction, or statement that temperature is incorporated into monitoring equipment internal calculations.
  - (5) Whether flow was measured on a wet or dry basis, whether CH<sub>4</sub> concentration was measured on a wet or dry basis, and if required for Equation II-4 of this subpart, weekly average moisture content for each week at which flow is measured for biogas collected for destruction, or statement that moisture content is incorporated into monitoring equipment internal calculations.
  - (6) Weekly average biogas pressure for each week at which flow is measured for biogas collected for destruction, or statement that pressure is incorporated into monitoring equipment internal calculations.
  - (7) CH<sub>4</sub> collection efficiency (CE) used in Equation II-5 of this subpart.
  - (8) Whether destruction occurs at the facility or off-site. If destruction occurs at the facility, also report whether a back-up destruction device is present at the facility, the annual operating hours for the primary destruction device, the annual operating hours for the back-up destruction device (if present), the destruction efficiency for the primary destruction device, and the destruction efficiency for the back-up destruction device (if present).
  - (9) For each anaerobic process from which some biogas is recovered, you must report the annual CH<sub>4</sub> emissions, as calculated by Equation II-6 of this subpart.
- (e) The total mass of CH<sub>4</sub> emitted from all anaerobic processes from which biogas is not recovered (calculated in Equation II-3 of this subpart) and from all anaerobic processes from which some biogas is recovered (calculated in Equation II-6 of this subpart) using Equation II-7 of this subpart.

[75 FR 39767, July 12, 2010, as amended at 76 FR 73905, Nov. 29, 2011; 81 FR 89267, Dec. 9, 2016]



## § 98.357 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the calibration records for all monitoring equipment, including the method or manufacturer's specification used for calibration.

## § 98.358 Definitions.

Except as provided below, all terms used in this subpart have the same meaning given in the CAA and subpart A of this part.

**Biogas** means the combination of CO<sub>2</sub>, CH<sub>4</sub>, and other gases produced by the biological breakdown of organic matter in the absence of oxygen.

**Dry milling** means the process in which shelled corn is milled by dry process, without an initial steeping step.

**Ethanol production** means an operation that produces ethanol from the fermentation of sugar, starch, grain, or cellulosic biomass feedstocks, or the production of ethanol synthetically from petrochemical feedstocks, such as ethylene or other chemicals.

**Food processing** means an operation used to manufacture or process meat, poultry, fruits, and/or vegetables as defined under NAICS 3116 (Meat Product Manufacturing) or NAICS 3114 (Fruit and Vegetable Preserving and Specialty Food Manufacturing). For information on NAICS codes, see <http://www.census.gov/eos/www/naics/>.

**Industrial wastewater** means water containing wastes from an industrial process. Industrial wastewater includes water which comes into direct contact with or results from the storage, production, or use of any raw material, intermediate product, finished product, by-product, or waste product. Examples of industrial wastewater include, but are not limited to, paper mill white water, wastewater from equipment cleaning, wastewater from air pollution control devices, rinse water, contaminated stormwater, and contaminated cooling water.

**Industrial wastewater treatment sludge** means solid or semi-solid material resulting from the treatment of industrial wastewater, including but not limited to biosolids, screenings, grit, scum, and settled solids.

**Wastewater treatment system** means the collection of all processes that treat or remove pollutants and contaminants, such as soluble organic matter, suspended solids, pathogenic organisms, and chemicals from wastewater prior to its reuse or discharge from the facility.

**Wet milling** means the process in which shelled corn is steeped in a dilute solution of sulfurous acid (sulfur dioxide dissolved in water) prior to further processing.

**Weekly average** means the sum of all values measured in a calendar week divided by the number of measurements.

[74 FR 56374, Oct. 30, 2009, as amended at 81 FR 89267, Dec. 9, 2016]

**Table II-1 to Subpart II of Part 98—Emission Factors**

| Factors                                                    | Default value | Units                                   |
|------------------------------------------------------------|---------------|-----------------------------------------|
| B <sub>0</sub> —for facilities monitoring COD              | 0.25          | Kg CH <sub>4</sub> /kg COD              |
| B <sub>0</sub> —for facilities monitoring BOD <sub>5</sub> | 0.60          | Kg CH <sub>4</sub> /kg BOD <sub>5</sub> |
| MCF—anaerobic reactor                                      | 0.8           | Fraction.                               |
| MCF—anaerobic deep lagoon (depth more than 2 m)            | 0.8           | Fraction.                               |
| MCF—anaerobic shallow lagoon (depth less than 2 m)         | 0.2           | Fraction.                               |

**Table II-2 to Subpart II of Part 98—Collection Efficiencies of Anaerobic Processes**

| Anaerobic process type                       | Cover type                | Methane collection efficiency |
|----------------------------------------------|---------------------------|-------------------------------|
| Covered anaerobic lagoon (biogas capture)    | Bank to bank, impermeable | 0.975                         |
|                                              | Modular, impermeable      | 0.70                          |
| Anaerobic sludge digester; anaerobic reactor | Enclosed Vessel           | 0.99                          |

## Subpart JJ—Manure Management

### § 98.360 Definition of the source category.

- (a) This source category consists of livestock facilities with manure management systems that emit 25,000 metric tons CO<sub>2</sub>e or more per year.
- (1) Table JJ-1 presents the minimum average annual animal population by animal group that is estimated to emit 25,000 metric tons CO<sub>2</sub>e or more per year. Facilities with an average annual animal population, as described in § 98.363(a)(1) and (2), below those listed in Table JJ-1 do not need to report under this rule. A facility with an annual animal population that exceeds those listed in Table JJ-1 should conduct a more thorough analysis to determine applicability.
- (2)
- (i) If a facility has more than one animal group present (e.g., swine and poultry), the facility must determine if they are required to report by calculating the combined animal group factor (CAGF) using equation JJ-1:

$$CAGF = \sum_{\text{Animal Groups}} \left( \frac{AAAP_{AG \text{ Facility}}}{APTL_{AG}} \right) \quad (\text{Eq. JJ-1})$$

Where:

CAGF = Combined Animal Group Factor

AAAP<sub>AG, Facility</sub> = Average annual animal population at the facility, by animal group

APTL<sub>AG</sub> = Animal population threshold level, as specified in Table JJ-1 of this section

(ii) If the calculated CAGF for a facility is less than 1, the facility is not required to report under this rule. If the CAGF is equal to or greater than 1, the facility must use more detailed applicability tables and tools to determine if they are required to report under this rule.

(b) A manure management system (MMS) is a system that stabilizes and/or stores livestock manure, litter, or manure wastewater in one or more of the following system components: Uncovered anaerobic lagoons, liquid/slurry systems with and without crust covers (including but not limited to ponds and tanks), storage pits, digesters, solid manure storage, dry lots (including feedlots), high-rise houses for poultry production (poultry without litter), poultry production with litter, deep bedding systems for cattle and swine, manure composting, and aerobic treatment.

(c) This source category does not include system components at a livestock facility that are unrelated to the stabilization and/or storage of manure such as daily spread or pasture/range/paddock systems or land application activities or any method of manure utilization that is not listed in § 98.360(b).

(d) This source category does not include manure management activities located off site from a livestock facility or off-site manure composting operations.

### § 98.361 Reporting threshold.

Livestock facilities must report GHG emissions under this subpart if the facility meets the reporting threshold as defined in 98.360(a) above, contains a manure management system as defined in 98.360(b) above, and meets the requirements of § 98.2(a)(1).

### § 98.362 GHGs to report.

(a) Livestock facilities must report annual aggregate CH<sub>4</sub> and N<sub>2</sub>O emissions for the following MMS components at the facility:

(1) Uncovered anaerobic lagoons.

(2) Liquid/slurry systems (with and without crust covers, and including but not limited to ponds and tanks).

(3) Storage pits.

(4) Digesters, including covered anaerobic lagoons.

(5) Solid manure storage.

(6) Dry lots, including feedlots.

(7) High-rise houses for poultry production (poultry without litter)

(8) Poultry production with litter.

- (9) Deep bedding systems for cattle and swine.
- (10) Manure composting.
- (11) Aerobic treatment.
- (b) A livestock facility that is subject to this rule only because of emissions from manure management system components is not required to report emissions from subparts C through PP (other than subpart JJ) of this part.
- (c) A livestock facility that is subject to this part because of emissions from source categories described in subparts C through PP of this part is not required to report emissions under subpart JJ of this part unless emissions from manure management systems are 25,000 metric tons CO<sub>2</sub>e per year or more.

### § 98.363 Calculating GHG emissions.

- (a) For all manure management system components listed in 98.360(b) except digesters, estimate the annual CH<sub>4</sub> emissions and sum for all the components to obtain total emissions from the manure management system for all animal types using Equation JJ-1.

$$\text{CH}_4 \text{ Emissions}_{\text{MMS}} (\text{metric tons/yr}) = \sum_{\text{animal type}} \left[ \sum_{\text{MMSC}} \left[ (\text{TVS}_{\text{AT}} \times \text{VS}_{\text{MMSC}} \times (1 - \text{VS}_{\text{ss}}) \times 365 \text{ days/yr} \times (\text{B}_0)_{\text{AT}} \times \text{MCF}_{\text{MMSC}}) \times 0.662 \text{ kg CH}_4/\text{m}^3 \times 1 \text{ metric ton}/1000 \text{ kg} \right] \right] \quad (\text{Eq. JJ-2})$$

Where:

MMSC = Manure management systems component.

TVS<sub>AT</sub> = Total volatile solids excreted by animal type, calculated using Equation JJ-3 of this section (kg/day).

VS<sub>MMSC</sub> = Fraction of the total manure for each animal type that is managed in MMS component MMSC, assumed to be equivalent to the fraction of VS in each MMS component.

VS<sub>ss</sub> = Volatile solids removal through solid separation; if solid separation occurs prior to the MMS component, use a default value from Table JJ-4 of this section; if no solid separation occurs, this value is set to 0.

(B<sub>0</sub>)<sub>AT</sub> = Maximum CH<sub>4</sub>-producing capacity for each animal type, as specified in Table JJ-2 of this section (m<sup>3</sup> CH<sub>4</sub>/kg VS).

MCF<sub>MMSC</sub> = CH<sub>4</sub> conversion factor for the MMS component, as specified in Table JJ-5 of this section (decimal).

$$\text{TVS}_{\text{AT}} = \text{Population}_{\text{AT}} \times \text{TAM}_{\text{AT}} \times \text{VS}_{\text{AT}}/1000 \quad (\text{Eq. JJ-3})$$

Where:

TVS<sub>AT</sub> = Daily total volatile solids excreted per animal type (kg/day).

Population<sub>AT</sub> = Average annual animal population contributing manure to the manure management system by animal type (head) (see description in § 98.363(a)(i) and (ii) below).

$TAM_{AT}$  = Typical animal mass for each animal type, using either default values in Table JJ-2 of this section or farm-specific data (kg/head).

$VS_{AT}$  = Volatile solids excretion rate for each animal type, using default values in Table JJ-2 or JJ-3 of this section (kg VS/day/1000 kg animal mass).

- (1) Average annual animal populations for static populations (e.g., dairy cows, breeding swine, layers) must be estimated by performing an animal inventory or review of facility records once each reporting year.
- (2) Average annual animal populations for growing populations (meat animals such as beef and veal cattle, market swine, broilers, and turkeys) must be estimated each year using the average number of days each animal is kept at the facility and the number of animals produced annually, and an equation similar or equal to Equation JJ-4 below, adapted from Equation 10.1 in *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 4, Chapter 10.

$$Population_{AT} = Days_{onsite_{AT}} \times \left( \frac{NAPA_{AT}}{365} \right) \quad (Eq. JJ-4)$$

Where:

$Population_{AT}$  = Average annual animal population (by animal type).

$Days_{onsite_{AT}}$  = Average number of days the animal is kept at the facility, by animal type.

$NAPA_{AT}$  = Number of animals produced annually, by animal type.

- (b) For each digester, calculate the total amount of  $CH_4$  emissions, and then sum the emissions from all digesters, as shown in Equation JJ-5 of this section.

$$H_4 \text{ Emissions}_{AD} = \sum_1^{AD} (CH_4C - CH_4D + CH_4L) \quad (Eq. JJ-5)$$

Where:

$CH_4 \text{ Emissions}_{AD}$  =  $CH_4$  emissions from anaerobic digestion (metric tons/yr).

$AD$  = Number of anaerobic digesters at the manure management facility.

$CH_4C$  =  $CH_4$  flow to digester combustion device, calculated using Equation JJ-6 of this section (metric tons  $CH_4$ /yr).

$CH_4D$  =  $CH_4$  destruction at digesters, calculated using Equation JJ-11 of this section (metric tons  $CH_4$ /yr)

$CH_4L$  = Leakage at digesters calculated using Equation JJ-12 of this section (metric tons  $CH_4$ /yr).

- (1) For each digester, calculate the annual CH<sub>4</sub> flow to the combustion device (CH<sub>4</sub>C) using Equation JJ-6 of this section. A fully integrated system that directly reports the quantity of CH<sub>4</sub> flow to the digester combustion device requires only summing the results of all monitoring periods for a given year to obtain CH<sub>4</sub>C.

$$CH_4C = \left( V \times \frac{C}{100\%} \times 0.0423 \times \frac{520^\circ R}{T} \times \frac{P}{1 \text{ atm}} \times \frac{0.454 \text{ metric ton}}{1,000 \text{ pounds}} \right) \quad (\text{Eq. JJ-6})$$

Where:

CH<sub>4</sub>C = CH<sub>4</sub> flow to digester combustion device (metric tons CH<sub>4</sub>/yr).

V = Average annual volumetric flow rate, calculated in Equation JJ-7 of this subsection (cubic feet CH<sub>4</sub>/yr).

C = Average annual CH<sub>4</sub> concentration of digester gas, calculated in Equation JJ-8 of this section (% wet basis).

0.0423 = Density of CH<sub>4</sub> lb/scf (at 520 °R or 60 °F and 1 atm).

T = Average annual temperature at which flow is measured, calculated in Equation JJ-9 of this section (°R).

P = Average annual pressure at which flow is measured, calculated in Equation JJ-10 of this section (atm).

- (2) For each digester, calculate the average annual volumetric flow rate, CH<sub>4</sub> concentration of digester gas, temperature, and pressure at which flow are measured using Equations JJ-7 through JJ-10 of this section.

$$V = \frac{\sum_{n=1}^{OD} \left( V_n \times \frac{1,440 \text{ minutes}}{\text{day}} \right)}{OD} \quad (\text{Eq. JJ-7})$$

Where:

V = Average annual volumetric flow rate (cubic feet CH<sub>4</sub>/yr).

OD = Operating days, number of days per year that the digester was operating (days/yr).

V<sub>n</sub> = Daily average volumetric flow rate for day n, as determined from daily monitoring as specified in § 98.364 (acfm).

$$C = \frac{\sum_{n=1}^{OD} C_n}{OD} \quad (\text{Eq. JJ-8})$$

Where:

C = Average annual CH<sub>4</sub> concentration of digester gas (% wet basis).

OD = Operating days, number of days per year that the digester was operating (days/yr).

C<sub>n</sub> = Average daily CH<sub>4</sub> concentration of digester gas for day n, as determined from daily monitoring as specified in § 98.364 (% wet basis).

$$T = \frac{\sum_{n=1}^{OD} T_n}{OD} \quad (\text{Eq. JJ-9})$$

Where:

T = Average annual temperature at which flow is measured (°R).

OD = Operating days, number of days per year that the digester was operating (days/yr).

T<sub>n</sub> = Temperature at which flow is measured for day n (°R).

$$P = \frac{\sum_{n=1}^{OD} P_n}{OD} \quad (\text{Eq. JJ-10})$$

Where:

P = Average annual pressure at which flow is measured (atm).

OD = Operating days, number of days per year that the digester was operating (days/yr).

P<sub>n</sub> = Pressure at which flow is measured for day n (atm).

- (3) For each digester, calculate the CH<sub>4</sub> destruction at the digester combustion device using Equation JJ-11 of this section.

$$CH_4D = CH_4C \times DE \times OH/H_{OH} \quad (\text{Eq. JJ-11})$$

Where:

CH<sub>4</sub>D = CH<sub>4</sub> destruction at digester combustion device (metric tons/yr).

CH<sub>4</sub>C = Annual quantity of CH<sub>4</sub> flow to digester combustion device, as calculated in Equation JJ-6 of this section (metric tons CH<sub>4</sub>).

DE = CH<sub>4</sub> destruction efficiency from flaring or burning in engine (lesser of manufacturer's specified destruction efficiency and 0.99). If the gas is transported off-site for destruction, use DE = 1.

OH = Number of hours combustion device is functioning in reporting year.

Hours = Hours in reporting year.

- (4) For each digester, calculate the CH<sub>4</sub> leakage using Equation JJ-12 of this section.

$$CH_4L = CH_4C \times \left( \frac{1}{CE} - 1 \right) \quad (\text{Eq. JJ-12})$$

Where:

CH<sub>4</sub>L = Leakage at digesters (metric tons/yr).

CH<sub>4</sub>C = Annual quantity of CH<sub>4</sub> flow to digester combustion device, as calculated in Equation JJ-6 of this section (metric tons CH<sub>4</sub>).

CE = CH<sub>4</sub> collection efficiency of anaerobic digester, as specified in Table JJ-6 of this section (decimal).

- (c) For each MMS component, estimate the annual N<sub>2</sub>O emissions and sum for all MMS components to obtain total emissions from the manure management system for all animal types using Equation JJ-13 of this section.

$$\text{Direct N}_2\text{O Emissions (metric tons/year)} = \sum_{\text{animal type}} \left[ \sum_{\text{MMSC}} N_{\text{ex AT}} \times N_{\text{ex,MMSC}} \times (1 - N_{\text{ss}}) \times EF_{\text{MMSC}} \times 365 \text{ days/yr} \right] \times 44 \text{ N}_2\text{O} / 28 \text{ N}_2\text{O-N} \times 1 \text{ metric ton} / 1000 \text{ kg} \quad (\text{Eq. JJ-13})$$

Where:

N<sub>ex AT</sub> = Daily total nitrogen excreted per animal type, calculated using Equation JJ-14 of this section (kg N/day).

N<sub>ex,MMSC</sub> = Fraction of the total manure for each animal type that is managed in MMS component MMSC, assumed to be equivalent to the fraction of N<sub>ex</sub> in each MMS component.

N<sub>ss</sub> = Nitrogen removal through solid separation; if solid separation occurs prior to the MMS component, use a default value from Table JJ-4 of this section; if no solid separation occurs, this value is set to 0.

EF<sub>MMSC</sub> = Emission factor for MMS component, as specified in Table JJ-7 of this section (kg N<sub>2</sub>O-N/kg N).

$$N_{\text{ex AT}} = \text{Population}_{\text{AT}} \times \text{TAM}_{\text{AT}} \times N_{\text{AT}} / 1000 \quad (\text{Eq. JJ-14})$$

Where:

N<sub>ex AT</sub> = Total nitrogen excreted per animal type (kg/day).



$\text{Population}_{\text{AT}}$  = Average annual animal population contributing manure to the manure management system by animal type (head) (see description in § 98.363(a)(i) and (ii)).

$\text{TAM}_{\text{AT}}$  = Typical animal mass by animal type, using either default values in Table JJ-2 of this section or farm-specific data (kg/head).

$\text{N}_{\text{AT}}$  = Nitrogen excretion rate by animal type, using default values in Tables JJ-2 or JJ-3 of this section (kg N/day/1000 kg animal mass).

- (d) Estimate the annual total facility emissions using Equation JJ-15 of this section.

$$\text{Total Emissions (metric tons CO}_2\text{e/yr)} = [(\text{CH}_4 \text{ emissions}_{\text{MMS}} + \text{CH}_4 \text{ emissions}_{\text{AD}}) \times 21] + [\text{Direct N}_2\text{O emissions} \times 310] \quad (\text{Eq. JJ-15})$$

Where:

$\text{CH}_4 \text{ emissions}_{\text{MMS}}$  = From Equation JJ-2 of this section.

$\text{CH}_4 \text{ emissions}_{\text{AD}}$  = From Equation JJ-5 of this section.

21 = Global Warming Potential of  $\text{CH}_4$ .

Direct  $\text{N}_2\text{O}$  emissions = From Equation JJ-13 of this section.

310 = Global Warming Potential of  $\text{N}_2\text{O}$ .

## § 98.364 Monitoring and QA/QC requirements.

- (a) Perform an annual animal inventory or review of facility records (for static populations) or population calculation (for growing populations) to determine the average annual animal population for each animal type (see description in § 98.363(a)(1) and (2)).
- (b) Perform an analysis on your operation to determine the fraction of total manure by weight for each animal type that is managed in each on-site manure management system component. If your system changes from previous reporting periods, you must reevaluate the fraction of total manure managed in each system component.
- (c) The  $\text{CH}_4$  concentration of gas from digesters must be determined using ASTM D1946-90 (Reapproved 2006) Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference see § 98.7). All gas composition monitors shall be calibrated prior to the first reporting year for biogas methane and carbon dioxide content using ASTM D1946-90 (Reapproved 2006) Standard Practice for Analysis of Reformed Gas by Gas Chromatography (incorporated by reference see § 98.7) and recalibrated either annually or at the minimum frequency specified by the manufacturer, whichever is more frequent, or whenever the error in the midrange calibration check exceeds  $\pm 10$  percent. All monitors shall be maintained as specified by the manufacturer.
- (d) All temperature and pressure monitors must be calibrated using the procedures and frequencies specified by the manufacturer. All equipment (temperature and pressure monitors) shall be maintained as specified by the manufacturer.

- (e) For digesters with gas collection systems, install, operate, maintain, and calibrate a gas flow meter capable of measuring the volumetric flow rate to provide data for the GHG emissions calculations, using the applicable methods specified in paragraphs (e)(1) through (e)(6) of this section or as specified by the manufacturer.
  - (1) ASME MFC-3M-2004 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, see § 98.7).
  - (2) ASME MFC-4M-1986 (Reaffirmed 1997) Measurement of Gas Flow by Turbine Meters (incorporated by reference, see § 98.7).
  - (3) ASME MFC-6M-1998 Measurement of Fluid Flow in Pipes Using Vortex Flowmeters (incorporated by reference, see § 98.7).
  - (4) ASME MFC-7M-1987 (Reaffirmed 1992) Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles (incorporated by reference, see § 98.7).
  - (5) ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters (incorporated by reference, see § 98.7).
  - (6) ASME MFC-18M-2001 Measurement of Fluid Flow using Variable Area Meters (incorporated by reference, see § 98.7).
- (f) If applicable, the owner or operator shall document the procedures used to ensure the accuracy of gas flow rate, gas composition, temperature, and pressure measurements. These procedures include, but are not limited to, calibration of fuel flow meters and other measurement devices. The estimated accuracy of measurements made with these devices shall also be recorded, and the technical basis for these estimates shall be provided.
- (g) Each gas flow meter shall be calibrated prior to the first reporting year and recalibrated either annually or at the minimum frequency specified by the manufacturer, whichever is more frequent. Each gas flow meter must have a rated accuracy of  $\pm 5$  percent or lower and be capable of correcting for the temperature and pressure and, if the gas composition monitor determines CH<sub>4</sub> concentration on a dry basis, moisture content.

#### **§ 98.365 Procedures for estimating missing data.**

- (a) A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required fuel sample is not taken), a substitute data value for the missing parameter shall be used in the calculations, according to the requirements in paragraph (b) of this section.
- (b) For missing gas flow rates or CH<sub>4</sub> content data, the substitute data value shall be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.

#### **§ 98.366 Data reporting requirements.**

- (a) In addition to the information required by § 98.3(c), each annual report must contain the following information:

- (1) List of manure management system components at the facility.
- (2) Fraction of manure from each animal type that is handled in each manure management system component.
- (3) Average annual animal population (for each animal type) for static populations or the results of Equation JJ-4 for growing populations.
- (4) Average number of days that growing animals are kept at the facility (for each animal type).
- (5) The number of animals produced annually for growing populations (for each animal type).
- (6) Typical animal mass (for each animal type).
- (7) Total facility emissions (results of Equation JJ-15).
- (8) CH<sub>4</sub> emissions from manure management system components listed in § 98.360(b), except digesters (results of Equation JJ-2).
- (9) VS value used (for each animal type).
- (10) B<sub>0</sub> value used (for each animal type).
- (11) Methane conversion factor used for each MMS component.
- (12) Average ambient temperature used to select each methane conversion factor.
- (13) N<sub>2</sub>O emissions (results of Equation JJ-13).
- (14) N value used for each animal type.
- (15) N<sub>2</sub>O emission factor selected for each MMS component.
- (b) Facilities with anaerobic digesters must also report:
  - (1) CH<sub>4</sub> emissions from anaerobic digesters (results of Equation JJ-5).
  - (2) CH<sub>4</sub> flow to the digester combustion device for each digester (results of Equation JJ-6, or value from fully integrated monitoring system as described in 98.363(b)).
  - (3) CH<sub>4</sub> destruction for each digester (results of Equation JJ-11).
  - (4) CH<sub>4</sub> leakage for each digester (results of Equation JJ-12).
  - (5) Total annual volumetric biogas flow for each digester (results of Equation JJ-7).
  - (6) Average annual CH<sub>4</sub> concentration for each digester (results of Equation JJ-8).
  - (7) Average annual temperature at which gas flow is measured for each digester (results of Equation JJ-9).
  - (8) Average annual gas flow pressure at which gas flow is measured for each digester (results of Equation JJ-10).
  - (9) Destruction efficiency used for each digester.
  - (10) Number of days per year that each digester was operating.
  - (11) Collection efficiency used for each digester.

## § 98.367 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the calibration records for all monitoring equipment, including the method or manufacturer's specification used for calibration.

## § 98.368 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

### Table JJ-1 to Subpart JJ of Part 98—Animal Population Threshold Level Below Which Facilities Are Not Required To Report Emissions Under Subpart JJ<sup>12</sup>

| Animal group | Average annual animal population (Head) <sup>3</sup> |
|--------------|------------------------------------------------------|
| Beef         | 29,300                                               |
| Dairy        | 3,200                                                |
| Swine        | 34,100                                               |
| Poultry:     |                                                      |
| Layers       | 723,600                                              |
| Broilers     | 38,160,000                                           |
| Turkeys      | 7,710,000                                            |

<sup>1</sup> The threshold head populations in this table were calculated using the most conservative assumptions (high VS and N values, maximum ambient temperatures, and the application of an uncertainty factor) to ensure that facilities at or near the 25,000 metric ton CO<sub>2</sub> e threshold level were not excluded from reporting.

<sup>2</sup> For facilities with more than one animal group present refer to § 98.360 (2) to estimate the combined animal group factor (CAGF), which is used to determine if a facility may be required to report.

<sup>3</sup> For all animal groups except dairy, the average annual animal population represents the total number of animals present at the facility. For dairy facilities, the average annual animal population represents the number of mature dairy cows present at the facility (note that heifers and calves were included in the emission estimates for dairy facilities using the assumption that the average annual animal population of heifers and calves at dairy facilities are equal to 30 percent of the mature dairy cow average annual animal population, therefore the average annual population for dairy facilities should not include heifers and calves, only dairy cows).

**Table JJ-2 to Subpart JJ of Part 98—Waste Characteristics Data**

| <b>Animal type</b>       | <b>Typical animal mass (kg)</b> | <b>Volatile solids excretion rate (kg VS/day/1000 kg animal mass)</b> | <b>Nitrogen excretion rate (kg N/day/1000 kg animal mass)</b> | <b>Maximum methane generation potential, B<sub>0</sub> (m<sup>3</sup> CH<sub>4</sub>/kg VS added)</b> |
|--------------------------|---------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Dairy Cows               | 604                             | See Table JJ-3                                                        | See Table JJ-3                                                | 0.24                                                                                                  |
| Dairy Heifers            | 476                             | See Table JJ-3                                                        | See Table JJ-3                                                | 0.17                                                                                                  |
| Dairy Calves             | 118                             | 6.41                                                                  | 0.30                                                          | 0.17                                                                                                  |
| Feedlot Steers           | 420                             | See Table JJ-3                                                        | See Table JJ-3                                                | 0.33                                                                                                  |
| Feedlot heifers          | 420                             | See Table JJ-3                                                        | See Table JJ-3                                                | 0.33                                                                                                  |
| Market Swine <60 lbs     | 16                              | 8.80                                                                  | 0.60                                                          | 0.48                                                                                                  |
| Market Swine 60-119 lbs  | 41                              | 5.40                                                                  | 0.42                                                          | 0.48                                                                                                  |
| Market Swine 120-179 lbs | 68                              | 5.40                                                                  | 0.42                                                          | 0.48                                                                                                  |
| Market Swine >180 lbs    | 91                              | 5.40                                                                  | 0.42                                                          | 0.48                                                                                                  |
| Breeding Swine           | 198                             | 2.60                                                                  | 0.24                                                          | 0.48                                                                                                  |
| Feedlot Sheep            | 25                              | 9.20                                                                  | 0.42                                                          | 0.36                                                                                                  |
| Goats                    | 64                              | 9.50                                                                  | 0.45                                                          | 0.17                                                                                                  |
| Horses                   | 450                             | 10.00                                                                 | 0.30                                                          | 0.33                                                                                                  |
| Hens >= 1 yr             | 1.8                             | 10.09                                                                 | 0.83                                                          | 0.39                                                                                                  |
| Pullets                  | 1.8                             | 10.09                                                                 | 0.62                                                          | 0.39                                                                                                  |
| Other Chickens           | 1.8                             | 10.80                                                                 | 0.83                                                          | 0.39                                                                                                  |
| Broilers                 | 0.9                             | 15.00                                                                 | 1.10                                                          | 0.36                                                                                                  |
| Turkeys                  | 6.8                             | 9.70                                                                  | 0.74                                                          | 0.36                                                                                                  |

**Table JJ-3 to Subpart JJ of Part 98—State-Specific Volatile Solids (VS) and Nitrogen (N) Excretion Rates for Cattle**

| State          | Volatile solids excretion rate (kg VS/day/1000 kg animal mass) |               |               |                 | Nitrogen excretion rate (kg VS/day/1000 kg animal mass) |               |               |                 |
|----------------|----------------------------------------------------------------|---------------|---------------|-----------------|---------------------------------------------------------|---------------|---------------|-----------------|
|                | Dairy cows                                                     | Dairy heifers | Feedlot steer | Feedlot heifers | Dairy cows                                              | Dairy heifers | Feedlot steer | Feedlot heifers |
| Alabama        | 8.40                                                           | 8.35          | 4.27          | 4.74            | 0.50                                                    | 0.46          | 0.36          | 0.38            |
| Alaska         | 7.30                                                           | 8.35          | 4.15          | 4.58            | 0.45                                                    | 0.46          | 0.35          | 0.37            |
| Arizona        | 10.37                                                          | 8.35          | 3.91          | 4.27            | 0.58                                                    | 0.46          | 0.33          | 0.34            |
| Arkansas       | 7.59                                                           | 8.35          | 3.98          | 4.35            | 0.46                                                    | 0.46          | 0.33          | 0.35            |
| California     | 10.02                                                          | 8.35          | 3.96          | 4.33            | 0.56                                                    | 0.46          | 0.33          | 0.34            |
| Colorado       | 10.25                                                          | 8.35          | 3.97          | 4.34            | 0.58                                                    | 0.46          | 0.33          | 0.35            |
| Connecticut    | 9.22                                                           | 8.35          | 4.41          | 4.93            | 0.53                                                    | 0.46          | 0.37          | 0.40            |
| Delaware       | 8.63                                                           | 8.35          | 4.19          | 4.64            | 0.51                                                    | 0.46          | 0.35          | 0.37            |
| Florida        | 8.90                                                           | 8.35          | 4.15          | 4.58            | 0.52                                                    | 0.46          | 0.35          | 0.37            |
| Georgia        | 9.07                                                           | 8.35          | 4.18          | 4.63            | 0.53                                                    | 0.46          | 0.35          | 0.37            |
| Hawaii         | 7.00                                                           | 8.35          | 4.15          | 4.58            | 0.44                                                    | 0.46          | 0.35          | 0.37            |
| Idaho          | 10.11                                                          | 8.35          | 4.03          | 4.42            | 0.57                                                    | 0.46          | 0.34          | 0.35            |
| Illinois       | 9.07                                                           | 8.35          | 4.15          | 4.59            | 0.52                                                    | 0.46          | 0.35          | 0.37            |
| Indiana        | 9.38                                                           | 8.35          | 3.98          | 4.35            | 0.54                                                    | 0.46          | 0.33          | 0.35            |
| Iowa           | 9.46                                                           | 8.35          | 3.93          | 4.28            | 0.54                                                    | 0.46          | 0.33          | 0.34            |
| Kansas         | 9.63                                                           | 8.35          | 3.97          | 4.35            | 0.55                                                    | 0.46          | 0.33          | 0.35            |
| Kentucky       | 7.89                                                           | 8.35          | 4.20          | 4.65            | 0.48                                                    | 0.46          | 0.35          | 0.37            |
| Louisiana      | 7.39                                                           | 8.35          | 4.07          | 4.48            | 0.45                                                    | 0.46          | 0.34          | 0.36            |
| Maine          | 8.99                                                           | 8.35          | 4.07          | 4.47            | 0.52                                                    | 0.46          | 0.34          | 0.36            |
| Maryland       | 9.02                                                           | 8.35          | 4.05          | 4.45            | 0.52                                                    | 0.46          | 0.34          | 0.35            |
| Massachusetts  | 8.63                                                           | 8.35          | 4.15          | 4.58            | 0.51                                                    | 0.46          | 0.35          | 0.37            |
| Michigan       | 10.05                                                          | 8.35          | 4.00          | 4.38            | 0.57                                                    | 0.46          | 0.34          | 0.35            |
| Minnesota      | 9.17                                                           | 8.35          | 3.89          | 4.24            | 0.53                                                    | 0.46          | 0.33          | 0.34            |
| Mississippi    | 8.19                                                           | 8.35          | 4.14          | 4.57            | 0.49                                                    | 0.46          | 0.35          | 0.37            |
| Missouri       | 8.02                                                           | 8.35          | 4.08          | 4.49            | 0.48                                                    | 0.46          | 0.34          | 0.36            |
| Montana        | 9.03                                                           | 8.35          | 4.23          | 4.69            | 0.52                                                    | 0.46          | 0.36          | 0.38            |
| Nebraska       | 9.09                                                           | 8.35          | 3.98          | 4.35            | 0.53                                                    | 0.46          | 0.33          | 0.35            |
| Nevada         | 9.65                                                           | 8.35          | 4.07          | 4.48            | 0.55                                                    | 0.46          | 0.34          | 0.36            |
| New Hampshire  | 9.44                                                           | 8.35          | 3.94          | 4.30            | 0.54                                                    | 0.46          | 0.33          | 0.34            |
| New Jersey     | 8.51                                                           | 8.35          | 3.98          | 4.36            | 0.50                                                    | 0.46          | 0.33          | 0.35            |
| New Mexico     | 10.34                                                          | 8.35          | 3.88          | 4.22            | 0.58                                                    | 0.46          | 0.32          | 0.33            |
| New York       | 9.42                                                           | 8.35          | 3.75          | 4.05            | 0.54                                                    | 0.46          | 0.31          | 0.32            |
| North Carolina | 9.38                                                           | 8.35          | 4.20          | 4.65            | 0.55                                                    | 0.46          | 0.35          | 0.37            |
| North Dakota   | 8.40                                                           | 8.35          | 3.88          | 4.22            | 0.50                                                    | 0.46          | 0.32          | 0.34            |
| Ohio           | 9.01                                                           | 8.35          | 3.96          | 4.33            | 0.52                                                    | 0.46          | 0.33          | 0.34            |

| State          | Volatile solids excretion rate (kg VS/day/1000 kg animal mass) |               |               |                 | Nitrogen excretion rate (kg VS/day/1000 kg animal mass) |               |               |                 |
|----------------|----------------------------------------------------------------|---------------|---------------|-----------------|---------------------------------------------------------|---------------|---------------|-----------------|
|                | Dairy cows                                                     | Dairy heifers | Feedlot steer | Feedlot heifers | Dairy cows                                              | Dairy heifers | Feedlot steer | Feedlot heifers |
| Oklahoma       | 8.58                                                           | 8.35          | 3.98          | 4.35            | 0.50                                                    | 0.46          | 0.33          | 0.35            |
| Oregon         | 9.40                                                           | 8.35          | 4.06          | 4.46            | 0.54                                                    | 0.46          | 0.34          | 0.36            |
| Pennsylvania   | 9.26                                                           | 8.35          | 3.98          | 4.35            | 0.53                                                    | 0.46          | 0.33          | 0.35            |
| Rhode Island   | 8.94                                                           | 8.35          | 4.36          | 4.87            | 0.52                                                    | 0.46          | 0.37          | 0.39            |
| South Carolina | 9.05                                                           | 8.35          | 4.15          | 4.58            | 0.53                                                    | 0.46          | 0.35          | 0.37            |
| South Dakota   | 9.45                                                           | 8.35          | 4.01          | 4.39            | 0.54                                                    | 0.46          | 0.34          | 0.35            |
| Tennessee      | 8.60                                                           | 8.35          | 4.48          | 5.02            | 0.51                                                    | 0.46          | 0.38          | 0.40            |
| Texas          | 9.51                                                           | 8.35          | 3.95          | 4.32            | 0.54                                                    | 0.46          | 0.33          | 0.34            |
| Utah           | 9.70                                                           | 8.35          | 3.88          | 4.22            | 0.55                                                    | 0.46          | 0.32          | 0.34            |
| Vermont        | 9.03                                                           | 8.35          | 4.10          | 4.52            | 0.52                                                    | 0.46          | 0.34          | 0.36            |
| Virginia       | 9.02                                                           | 8.35          | 3.98          | 4.35            | 0.53                                                    | 0.46          | 0.33          | 0.35            |
| Washington     | 10.36                                                          | 8.35          | 4.07          | 4.47            | 0.58                                                    | 0.46          | 0.34          | 0.36            |
| West Virginia  | 8.13                                                           | 8.35          | 4.65          | 5.25            | 0.48                                                    | 0.46          | 0.40          | 0.42            |
| Wisconsin      | 9.34                                                           | 8.35          | 3.95          | 4.31            | 0.54                                                    | 0.46          | 0.33          | 0.34            |
| Wyoming        | 9.29                                                           | 8.35          | 4.17          | 4.61            | 0.53                                                    | 0.46          | 0.35          | 0.37            |

**Table JJ-4 to Subpart JJ of Part 98—Volatile Solids and Nitrogen Removal through Solids Separation**

| Type of solids separation | Volatile solids removal (decimal) | Nitrogen removal (decimal) |
|---------------------------|-----------------------------------|----------------------------|
| Gravity                   | 0.60                              | 0.60                       |
| Mechanical:               |                                   |                            |
| Stationary Screen         | 0.20                              | 0.10                       |
| Vibrating Screen          | 0.15                              | 0.15                       |
| Screw Press               | 0.25                              | 0.15                       |
| Centrifuge                | 0.50                              | 0.25                       |
| Roller drum               | 0.25                              | 0.15                       |



| Type of solids separation | Volatile solids removal (decimal) | Nitrogen removal (decimal) |
|---------------------------|-----------------------------------|----------------------------|
| Belt press/screen         | 0.50                              | 0.30                       |

**Table JJ-5 to Subpart JJ of Part 98—Methane Conversion Factors**

| Manure Management System Component                       | MCFs by Average Annual Ambient Temperature (degrees C) |     |     |     |     |           |     |     |     |     |     |     |     |     |     |       |     |     |     |  |
|----------------------------------------------------------|--------------------------------------------------------|-----|-----|-----|-----|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-----|--|
|                                                          | Cool                                                   |     |     |     |     | Temperate |     |     |     |     |     |     |     |     |     | Warm  |     |     |     |  |
|                                                          | <10                                                    | 11  | 12  | 13  | 14  | 15        | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25    | 26  | 27  | >28 |  |
| Uncovered Anaerobic Lagoon                               | 66%                                                    | 68% | 70% | 71% | 73% | 74%       | 75% | 76% | 77% | 77% | 78% | 78% | 78% | 79% | 79% | 79%   | 79% | 80% | 80% |  |
| Liquid/slurry (with crust cover)                         | 10%                                                    | 11% | 13% | 14% | 15% | 17%       | 18% | 20% | 22% | 24% | 26% | 29% | 31% | 34% | 37% | 41%   | 44% | 48% | 50% |  |
| Liquid/slurry (w/o crust cover)                          | 17%                                                    | 19% | 20% | 22% | 25% | 27%       | 29% | 32% | 35% | 39% | 42% | 46% | 50% | 55% | 60% | 65%   | 71% | 78% | 80% |  |
| Storage pits <1 month                                    | 3.0%                                                   |     |     |     |     | 3.0%      |     |     |     |     |     |     |     |     |     | 30.0% |     |     |     |  |
| Storage pits >1 month                                    | 17%                                                    | 19% | 20% | 22% | 25% | 27%       | 29% | 32% | 35% | 39% | 42% | 46% | 50% | 55% | 60% | 65%   | 71% | 78% | 80% |  |
| Solid manure storage                                     | 2.0%                                                   |     |     |     |     | 4.0%      |     |     |     |     |     |     |     |     |     | 5.0%  |     |     |     |  |
| Dry lots (including feedlots)                            | 1.0%                                                   |     |     |     |     | 1.5%      |     |     |     |     |     |     |     |     |     | 2.0%  |     |     |     |  |
| High-rise houses for poultry production (without litter) | 1.5%                                                   |     |     |     |     | 1.5%      |     |     |     |     |     |     |     |     |     | 1.5%  |     |     |     |  |
| Poultry production with litter                           | 1.5%                                                   |     |     |     |     | 1.5%      |     |     |     |     |     |     |     |     |     | 1.5%  |     |     |     |  |
| Deep bedding systems for cattle and swine (<1 month)     | 3.0%                                                   |     |     |     |     | 3.0%      |     |     |     |     |     |     |     |     |     | 30.0% |     |     |     |  |
| Deep bedding systems for cattle and swine (>1 month)     | 17%                                                    | 19% | 20% | 22% | 25% | 27%       | 29% | 32% | 35% | 39% | 42% | 46% | 50% | 55% | 60% | 65%   | 71% | 78% | 80% |  |
| Manure Composting - In Vessel                            | 0.5%                                                   |     |     |     |     | 0.5%      |     |     |     |     |     |     |     |     |     | 0.5%  |     |     |     |  |
| Manure Composting - Static Pile                          | 0.5%                                                   |     |     |     |     | 0.5%      |     |     |     |     |     |     |     |     |     | 0.5%  |     |     |     |  |
| Manure Composting- Extensive/ Passive                    | 0.5%                                                   |     |     |     |     | 1.0%      |     |     |     |     |     |     |     |     |     | 1.5%  |     |     |     |  |
| Manure Composting- Intensive                             | 0.5%                                                   |     |     |     |     | 1.0%      |     |     |     |     |     |     |     |     |     | 1.5%  |     |     |     |  |
| Aerobic Treatment                                        | 0.0%                                                   |     |     |     |     | 0.0%      |     |     |     |     |     |     |     |     |     | 0.0%  |     |     |     |  |

**Table JJ-6 to Subpart JJ of Part 98—Collection Efficiencies of Anaerobic Digesters**

| Anaerobic digester type                         | Cover type                | Methane collection efficiency |
|-------------------------------------------------|---------------------------|-------------------------------|
| Covered anaerobic lagoon (biogas capture)       | Bank to bank, impermeable | 0.975                         |
|                                                 | Modular, impermeable      | 0.70                          |
| Complete mix, fixed film, or plug flow digester | Enclosed Vessel           | 0.99                          |

**Table JJ-7 to Subpart JJ of Part 98—Nitrous Oxide Emission Factors (kg N<sub>2</sub>O-N/kg Kjdl N)**

| Manure management system component                   | N <sub>2</sub> O emission factor |
|------------------------------------------------------|----------------------------------|
| Uncovered anaerobic lagoon                           | 0                                |
| Liquid/Slurry (with crust cover)                     | 0.005                            |
| Liquid/Slurry (without crust cover)                  | 0                                |
| Storage pits                                         | 0.002                            |
| Digesters                                            | 0                                |
| Solid manure storage                                 | 0.005                            |
| Dry lots (including feedlots)                        | 0.02                             |
| High-rise house for poultry (poultry without litter) | 0.001                            |
| Poultry production with litter                       | 0.001                            |
| Deep bedding for cattle and swine (active mix)       | 0.07                             |
| Deep bedding for cattle and swine (no mix)           | 0.01                             |
| Manure Composting (in vessel)                        | 0.006                            |
| Manure Composting (intensive)                        | 0.1                              |
| Manure Composting (passive)                          | 0.01                             |
| Manure Composting (static)                           | 0.006                            |
| Aerobic Treatment (forced aeration)                  | 0.005                            |
| Aerobic Treatment (natural aeration)                 | 0.01                             |

## Subpart KK [Reserved]

## Subpart LL—Suppliers of Coal-based Liquid Fuels

### § 98.380 Definition of the source category.

This source category consists of producers, importers, and exporters of products listed in Table MM-1 of subpart MM that are coal-based (coal-to-liquid products).

- (a) A producer is the owner or operator of a coal-to-liquids facility. A coal-to-liquids facility is any facility engaged in converting coal into liquid products using a process involving conversion of coal into gas and then into liquids (e.g., Fischer-Tropsch) or conversion of coal directly into liquids (i.e., direct liquefaction).
- (b) An importer or exporter shall have the same meaning given in § 98.6.

### § 98.381 Reporting threshold.

Any supplier of coal-to-liquid products who meets the requirements of § 98.2(a)(4) must report GHG emissions.

### § 98.382 GHGs to report.

Suppliers of coal-based liquid fuels must report the CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of fossil-fuel products (besides coal or crude oil) produced, used as feedstock, imported, or exported during the calendar year. Additionally, producers must report CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of any biomass co-processed with fossil fuel-based feedstocks.

[81 FR 89267, Dec. 9, 2016]

### § 98.383 Calculating GHG emissions.

Suppliers of coal-based liquid fuels must follow the calculation methods of § 98.393 as if they applied to the appropriate coal-to-liquid product supplier (i.e., calculation methods for refiners apply to producers of coal-to-liquid products and calculation methods for importers and exporters of petroleum products apply to importers and exporters of coal-to-liquid products).

- (a) In calculation methods in § 98.393 for petroleum products or petroleum-based products, suppliers of coal-to-liquid products shall also include coal-to-liquid products.
- (b) In calculation methods in § 98.393 for non-crude feedstocks or non-crude petroleum feedstocks, producers of coal-to-liquid products shall also include coal-to-liquid products that enter the facility to be further processed or otherwise used on site.
- (c) In calculation methods in § 98.393 for petroleum feedstocks, suppliers of coal-to-liquid products shall also include coal and coal-to-liquid products that enter the facility to be further processed or otherwise used on site.

[81 FR 89267, Dec. 9, 2016]

### § 98.384 Monitoring and QA/QC requirements.

Suppliers of coal-based liquid fuels must follow the monitoring and QA/QC requirements in § 98.394 as if they applied to the appropriate coal-to-liquid product supplier. Any monitoring and QA/QC requirement for petroleum products in § 98.394 also applies to coal-to-liquid products.

[81 FR 89267, Dec. 9, 2016]

## § 98.385 Procedures for estimating missing data.

Suppliers of coal-based liquid fuels must follow the procedures for estimating missing data in § 98.395 as if they applied to the appropriate coal-to-liquid product supplier. Any procedure for estimating missing data for petroleum products in § 98.395 also applies to coal-to-liquid products.

[81 FR 89267, Dec. 9, 2016]

## § 98.386 Data reporting requirements.

In addition to the information required by § 98.3(c), the following requirements apply:

- (a) Producers shall report the following information for each coal-to-liquid facility:
  - (1) [Reserved]
  - (2) For each product listed in Table MM-1 of subpart MM of this part that enters the coal-to-liquid facility to be further processed or otherwise used on site, report the total annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product.
  - (3) For each feedstock reported in paragraph (a)(2) of this section that was produced by blending a fossil fuel-based product with a biomass-based product, report the percent of the volume reported in paragraph (a)(2) of this section that is fossil fuel-based (excluding any denaturant that may be present in any ethanol product).
  - (4)-(5) [Reserved]
  - (6) For each product (leaving the coal-to-liquid facility) listed in Table MM-1 of subpart MM of this part, report the total annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product. Those products that enter the facility, but are not reported in (a)(2), shall not be reported under this paragraph.
  - (7) For each product reported in paragraph (a)(6) of this section that was produced by blending a fossil fuel-based product with a biomass-based product, report the percent of the volume reported in paragraph (a)(6) of this section that is fossil fuel-based (excluding any denaturant that may be present in any ethanol product).
  - (8) [Reserved]
  - (9) For every feedstock reported in paragraph (a)(2) of this section for which Calculation Method 2 in § 98.393(f)(2) was used to determine an emissions factor, report:
    - (i) The number of samples collected according to § 98.394(c).
    - (ii) The sampling standard method used.
    - (iii) The carbon share test results in percent mass.
    - (iv) The standard method used to test carbon share.
    - (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or per metric ton of product.
  - (10) For every non-solid feedstock reported in paragraph (a)(2) of this section for which Calculation Method 2 in § 98.393(f)(2) was used to determine an emissions factor, report:

- (i) The density test results in metric tons per barrel.
    - (ii) The standard method used to test density.
  - (11) For every product reported in paragraph (a)(6) of this section for which Calculation Method 2 in § 98.393(f)(2) was used to determine an emissions factor, report:
    - (i) The number of samples collected according to § 98.394(c).
    - (ii) The sampling standard method used.
    - (iii) The carbon share test results in percent mass.
    - (iv) The standard method used to test carbon share.
    - (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or metric ton of product.
  - (12) For every non-solid product reported in paragraph (a)(6) of this section for which Calculation Method 2 of subpart MM of this part was used to determine an emissions factor, report:
    - (i) The density test results in metric tons per barrel.
    - (ii) The standard method used to test density.
  - (13) [Reserved]
  - (14) For each specific type of biomass that enters the coal-to-liquid facility to be co-processed with fossil fuel-based feedstock to produce a product reported in paragraph (a)(6) of this section, report the annual quantity in metric tons or barrels.
  - (15) [Reserved]
  - (16) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each feedstock reported in paragraph (a)(2) of this section that were calculated according to § 98.393(b) or (h).
  - (17) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each product (leaving the coal-to-liquid facility) reported in paragraph (a)(6) of this section that were calculated according to § 98.393(a) or (h).
  - (18) Annual CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each type of biomass feedstock co-processed with fossil fuel-based feedstocks reported in paragraph (a)(14) of this section, calculated according to § 98.393(c).
  - (19) Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of all products, calculated according to § 98.393(d).
  - (20) Annual quantity of bulk NGLs in metric tons or barrels received for processing during the reporting year. Report only quantities of bulk NGLs not reported in paragraph (a)(2) of this section.
- (b) In addition to the information required by § 98.3(c), each importer shall report all of the following information at the corporate level:
- (1) [Reserved]
  - (2) For each product listed in Table MM-1 of subpart MM of this part, report the total annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product as listed in Table MM-1 of subpart MM of this part.

- (3) For each product reported in paragraph (b)(2) of this section that was produced by blending a fossil fuel-based product with a biomass-based product, report the percent of the volume reported in paragraph (b)(2) of this section that is fossil fuel-based (excluding any denaturant that may be present in any ethanol product).
- (4) [Reserved]
- (5) For each product reported in paragraph (b)(2) of this section for which Calculation Method 2 in § 98.393(f)(2) used was used to determine an emissions factor, report:
  - (i) The number of samples collected according to § 98.394(c)
  - (ii) The sampling standard method used.
  - (iii) The carbon share test results in percent mass.
  - (iv) The standard method used to test carbon share.
  - (v) The calculated CO<sub>2</sub> emissions factor in metric tons per barrel or per metric ton of product.
- (6) For each non-solid product reported in paragraph (b)(2) of this section for which Calculation Method 2 in § 98.393(f)(2) was used to determine an emissions factor, report:
  - (i) The density test results in metric tons per barrel.
  - (ii) The standard method used to test density.
- (7) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each imported product reported in paragraph (b)(2) of this section, calculated according to § 98.393(a).
- (8) The total sum of CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of all imported products, calculated according to § 98.393(e).
- (c) In addition to the information required by § 98.3(c), each exporter shall report all of the following information at the corporate level:
  - (1) [Reserved]
  - (2) For each product listed in table MM-1 of subpart MM of this part, report the total annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product.
  - (3) For each product reported in paragraph (c)(2) of this section that was produced by blending a fossil fuel-based product with a biomass-based product, report the percent of the volume reported in paragraph (c)(2) of this section that is fossil fuel-based (excluding any denaturant that may be present in any ethanol product).
  - (4) [Reserved]
  - (5) For each product reported in paragraph (c)(2) of this section for which Calculation Method 2 in § 98.393(f)(2) was used to determine an emissions factor, report:
    - (i) The number of samples collected according to § 98.394(c).
    - (ii) The sampling standard method used.
    - (iii) The carbon share test results in percent mass.

- (iv) The standard method used to test carbon share.
- (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or per metric ton of product.
- (6) For each non-solid product reported in paragraph (c)(2) of this section for which Calculation Method 2 in § 98.393(f)(2) used was used to determine an emissions factor, report:
  - (i) The density test results in metric tons per barrel.
  - (ii) The standard method used to test density.
- (7) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each exported product reported in paragraph (c)(2) of this section, calculated according to § 98.393(a).
- (8) Total sum of CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of all exported products, calculated according to § 98.393(e).

(d) **Blended feedstock and products.**

- (1) Producers, exporters, and importers must report the following information for each blended product and feedstock where emissions were calculated according to § 98.393(i):
  - (i) Volume or mass of each blending component.
  - (ii) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each blended feedstock or product, using Equation MM-12 or Equation MM-13 of § 98.393.
  - (iii) Whether it is a blended feedstock or a blended product.
- (2) For a product that enters the facility to be further refined or otherwise used on site that is a blended feedstock, producers must meet the reporting requirements of paragraph (a)(2) of this section by reflecting the individual components of the blended feedstock.
- (3) For a product that is produced, imported, or exported that is a blended product, producers, importers, and exporters must meet the reporting requirements of paragraphs (a)(6), (b)(2), and (c)(2) of this section, as applicable, by reflecting the individual components of the blended product.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66475, Oct. 28, 2010; 78 FR 71972, Nov. 29, 2013; 81 FR 89267, Dec. 9, 2016]

**§ 98.387 Records that must be retained.**

Suppliers of coal-based liquid fuels must retain records according to the requirements in § 98.397 as if they applied to the appropriate coal-to-liquid product supplier (e.g., retaining copies of all reports submitted to EPA under § 98.386 and records to support information contained in those reports). Any records for petroleum products that are required to be retained in § 98.397 are also required for coal-to-liquid products.

[81 FR 89268, Dec. 9, 2016]

**§ 98.388 Definitions.**

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Subpart MM—Suppliers of Petroleum Products**



### § 98.390 Definition of the source category.

This source category consists of petroleum refineries and importers and exporters of petroleum products and natural gas liquids as listed in Table MM-1 of this subpart.

- (a) A petroleum refinery for the purpose of this subpart is any facility engaged in producing petroleum products through the distillation of crude oil.
- (b) A refiner is the owner or operator of a petroleum refinery.
- (c) Importer has the same meaning given in § 98.6 and includes any entity that imports petroleum products or natural gas liquids as listed in Table MM-1 of this subpart. Any blender or refiner of refined or semi-refined petroleum products shall be considered an importer if it otherwise satisfies the aforementioned definition.
- (d) Exporter has the same meaning given in § 98.6 and includes any entity that exports petroleum products or natural gas liquids as listed in Table MM-1 of this subpart. Any blender or refiner of refined or semi-refined petroleum products shall be considered an exporter if it otherwise satisfies the aforementioned definition.

### § 98.391 Reporting threshold.

Any supplier of petroleum products who meets the requirements of § 98.2(a)(4) must report GHG emissions.

### § 98.392 GHGs To report.

Suppliers of petroleum products must report the CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each petroleum product and natural gas liquid produced, used as feedstock, imported, or exported during the calendar year. Additionally, refiners must report CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of any biomass co-processed with petroleum feedstocks.

### § 98.393 Calculating GHG emissions.

- (a) *Calculation for individual products produced, imported, or exported.*
  - (1) Except as provided in paragraphs (h) and (i) of this section, any refiner, importer, or exporter shall calculate CO<sub>2</sub> emissions from each individual petroleum product and natural gas liquid using Equation MM-1 of this section.

$$CO_{2i} = Product_i \times EF_i \quad (Eq. MM-1)$$

Where:

CO<sub>2i</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each petroleum product or natural gas liquid "i" (metric tons).

Product<sub>i</sub> = Annual volume of product "i" produced, imported, or exported by the reporting party (barrels). For refiners, this volume only includes products ex refinery gate, and excludes products that entered the refinery but are not reported under § 98.396(a)(2). For natural gas liquids, volumes shall reflect the individual components of the product as listed in Table MM-1 to subpart MM.

EF<sub>i</sub> = Product-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel).

- (2) In the event that an individual petroleum product is produced as a solid rather than liquid any refiner, importer, or exporter shall calculate CO<sub>2</sub> emissions using Equation MM-1 of this section.

Where:

CO<sub>2i</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each petroleum product "i" (metric tons).

Product<sub>i</sub> = Annual mass of product "i" produced, imported, or exported by the reporting party (metric tons). For refiners, this mass only includes products ex refinery gate, and excludes products that entered the refinery but are not reported under § 98.396(a)(2).

EF<sub>i</sub> = Product-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per metric ton of product).

(b) *Calculation for individual products that enter a refinery as a non-crude feedstock.*

- (1) Except as provided in paragraphs (h) and (i) of this section, any refiner shall calculate CO<sub>2</sub> emissions from each non-crude feedstock using Equation MM-2 of this section.

$$CO_{2j} = \text{Feedstock}_j \times EF_j \quad (\text{Eq. MM-2})$$

Where:

CO<sub>2j</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each non-crude feedstock "j" (metric tons).

Feedstock<sub>j</sub> = Annual volume of a petroleum product or natural gas liquid "j" that enters the refinery to be further refined or otherwise used on site (barrels). For natural gas liquids, volumes shall reflect the individual components of the product as listed in table MM-1 of this subpart.

EF<sub>j</sub> = Feedstock-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel).

- (2) In the event that a non-crude feedstock enters a refinery as a solid rather than liquid, the refiner shall calculate CO<sub>2</sub> emissions using Equation MM-2 of this section.

Where:

CO<sub>2j</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each non-crude feedstock "j" (metric tons).

Feedstock<sub>j</sub> = Annual mass of a petroleum product "j" that enters the refinery to be further refined or otherwise used on site (metric tons).

EF<sub>j</sub> = Feedstock-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per metric ton of feedstock).

(c) *Calculation for biomass co-processed with petroleum feedstocks.*

- (1) Refiners shall calculate CO<sub>2</sub> emissions from each type of biomass that enters a refinery and is co-processed with petroleum feedstocks using Equation MM-3 of this section.

$$CO_{2m} = Biomass_m \cdot EF_m \quad (\text{Eq. MM-3})$$

Where:

$CO_{2m}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of each type of biomass "m" (metric tons).

$Biomass_m$  = Annual volume of a specific type of biomass that enters the refinery and is co-processed with petroleum feedstocks to produce a petroleum product reported under paragraph (a) of this section (barrels).

$EF_m$  = Biomass-specific  $CO_2$  emission factor (metric tons  $CO_2$  per barrel).

- (2) In the event that biomass enters a refinery as a solid rather than liquid and is co-processed with petroleum feedstocks, the refiner shall calculate  $CO_2$  emissions from each type of biomass using Equation MM-3 of this section.

Where:

$CO_{2m}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of each type of biomass "m" (metric tons).

$Biomass_m$  = Total annual mass of a specific type of biomass that enters the refinery to be co-processed with petroleum feedstocks to produce a petroleum product reported under paragraph (a) of this section (metric tons).

$EF_m$  = Biomass-specific  $CO_2$  emission factor (metric tons  $CO_2$  per metric ton of biomass).

- (d) **Summary calculation for refinery products.** Refiners shall calculate annual  $CO_2$  emissions from all products using Equation MM-4 of this section.

$$CO_{2r} = \sum (CO_{2i}) - \sum (CO_{2j}) - \sum (CO_{2m}) \quad (\text{Eq. MM-4})$$

Where:

$CO_{2r}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of all petroleum products and natural gas liquids (ex refinery gate) minus non-crude feedstocks and any biomass to be co-processed with petroleum feedstocks.

$CO_{2i}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of each petroleum product or natural gas liquid "i" (metric tons).

$CO_{2j}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of each non-crude feedstock "j" (metric tons).

$CO_{2m}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of each type of biomass "m" (metric tons).

- (e) **Summary calculation for importer and exporter products.** Importers and exporters shall calculate annual CO<sub>2</sub> emissions from all petroleum products and natural gas liquids imported or exported, respectively, using Equations MM-1 and MM-5 of this section.

$$CO_{2x} = \sum (CO_{2i}) \quad (\text{Eq. MM-5})$$

Where:

CO<sub>2x</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each petroleum product or natural gas liquid "i" (metric tons).

CO<sub>2i</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of all petroleum products and natural gas liquids.

- (f) **Emission factors for petroleum products and natural gas liquids.** The emission factor (EF<sub>ij</sub>) for each petroleum product and natural gas liquid shall be determined using either of the calculation methods described in paragraphs (f)(1) or (f)(2) of this section. The same calculation method must be used for the entire quantity of the product for the reporting year. For refiners, the quantity of a product that enters a refinery (i.e., a non-crude feedstock) is considered separate from the quantity of a product ex refinery gate.

- (1) **Calculation Method 1.** To determine the emission factor (i.e., EF<sub>i</sub> in Equation MM-1) for solid products, multiply the default carbon share factor (i.e., percent carbon by mass) in column B of Table MM-1 to this subpart for the appropriate product by 44/12. For all other products, use the default CO<sub>2</sub> emission factor listed in column C of Table MM-1 of this subpart for the appropriate product.

- (2) **Calculation Method 2.**

- (i) For solid products, develop emission factors according to Equation MM-6 of this section using a value of 1 for density and direct measurements of carbon share according to methods set forth in § 98.394(c). For all other products, develop emission factors according to Equation MM-6 of this section using direct measurements of density and carbon share according to methods set forth in § 98.394(c).

$$EF_{i,j} = \text{Density} \times \text{Carbon Share} \times (44/12) \quad (\text{Eq. MM-6})$$

Where:

EF<sub>ij</sub> = Emission factor of the petroleum product or natural gas liquid (metric tons CO<sub>2</sub> per barrel or per metric ton of product).

Density = Density of the petroleum product or natural gas liquid (metric tons per barrel for non-solid products, 1 for solid products).

Carbon share = Percent of total mass that carbon represents in the petroleum product or natural gas liquid, expressed as a fraction (e.g., 75% would be expressed as 0.75 in the above equation).

44/12 = Conversion factor for carbon to carbon dioxide.

- (ii) If you use a standard method that involves gas chromatography to determine the percent mass of each component in a product, calculate the product's carbon share using Equation MM-7 of this section.

$$\text{Carbon Share} = \sum (\% \text{Composition}_i \times \% \text{Mass}_{i,n}) \quad (\text{Eq. MM-7})$$

Where:

Carbon Share = Percent of total mass that carbon represents in the petroleum product or natural gas liquid.

$\% \text{Composition}_i$  = Percent of total mass that each molecular component in the petroleum product or natural gas liquid represents as determined by the procedures in the selected standard method.

$\% \text{Mass}_{i,n}$  = Percent of total mass that carbon represents in each molecular component of the petroleum product or natural gas liquid.

- (g) **Emission factors for biomass co-processed with petroleum feedstocks.** Refiners shall use the most appropriate default CO<sub>2</sub> emission factor (EF<sub>m</sub>) for biomass in Table MM-2 of this subpart to calculate CO<sub>2</sub> emissions in paragraph (c) of this section.
- (h) **Special procedures for blended biomass-based fuels.** In the event that some portion of a petroleum product is biomass-based and was not derived by co-processing biomass and petroleum feedstocks together (i.e., the petroleum product was produced by blending a petroleum-based product with a biomass-based fuel), the reporting party shall calculate emissions for the petroleum product according to one of the methods in paragraphs (h)(1) through (h)(4) of this section, as appropriate.
- (1) A reporter using Calculation Method 1 to determine the emission factor of a petroleum product shall calculate the CO<sub>2</sub> emissions associated with that product using Equation MM-8 of this section in place of Equation MM-1 of this section.

$$\text{CO}_{2i} = \text{Product}_i \times \text{EF}_i \times \% \text{Vol}_i \quad (\text{Eq. MM-8})$$

Where:

CO<sub>2i</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each petroleum product "i" (metric tons).

Product<sub>i</sub> = Annual volume of each petroleum product "i" produced, imported, or exported by the reporting party (barrels). For refiners, this volume only includes products ex refinery gate.

EF<sub>i</sub> = Petroleum product-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel) from Table MM-1 of this subpart.

$\% \text{Vol}_i$  = Percent volume of product "i" that is petroleum-based, not including any denaturant that may be present in any ethanol product, expressed as a fraction (e.g., 75% would be expressed as 0.75 in the above equation).

- (2) A refinery using Calculation Method 1 of this subpart to determine the emission factor of a non-crude petroleum feedstock shall calculate the CO<sub>2</sub> emissions associated with that feedstock using Equation MM-9 of this section in place of Equation MM-2 of this section.

$$CO_{2j} = \text{Feedstock}_j \cdot EF_j \cdot \%Vol_j \quad (\text{Eq. MM-9})$$

Where:

CO<sub>2j</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each non-crude feedstock "j" (metric tons).

Feedstock<sub>j</sub> = Annual volume of each petroleum product "j" that enters the refinery as a feedstock to be further refined or otherwise used on site (barrels).

EF<sub>j</sub> = Non-crude petroleum feedstock-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel).

%Vol<sub>j</sub> = Percent volume of feedstock "j" that is petroleum-based, not including any denaturant that may be present in any ethanol product, expressed as a fraction (e.g., 75% would be expressed as 0.75 in the above equation).

(3) *Calculation Method 2 procedures for products.*

- (i) A reporter using Calculation Method 2 of this subpart to determine the emission factor of a petroleum product that does not contain denatured ethanol must calculate the CO<sub>2</sub> emissions associated with that product using Equation MM-10 of this section in place of Equation MM-1 of this section.

$$CO_{2i} = (\text{Product}_i \cdot EF_i) - (\text{Product}_i \cdot EF_m \cdot \%Vol_m) \quad (\text{Eq. MM-10})$$

where:

CO<sub>2i</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each product "i" (metric tons).

Product<sub>i</sub> = Annual volume of each petroleum product "i" produced, imported, or exported by the reporting party (barrels). For refiners, this volume only includes products ex refinery gate.

EF<sub>i</sub> = Product-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel).

EF<sub>m</sub> = Default CO<sub>2</sub> emission factor from Table MM-2 to subpart MM that most closely represents the component of product "i" that is biomass-based.

%Vol<sub>m</sub> = Percent volume of petroleum product "i" that is biomass-based, expressed as a fraction (e.g., 75% would be expressed as 0.75 in the above equation).

- (ii) In the event that a petroleum product contains denatured ethanol, importers and exporters must follow Calculation Method 1 procedures in paragraph (h)(1) of this section; and refineries must sample the petroleum portion of the blended biomass-based fuel prior to blending and calculate CO<sub>2</sub> emissions using Equation MM-10a of this section.

$$CO_{2i} = Product_p \cdot EF_i \quad (\text{Eq. MM-10a})$$

where:

CO<sub>2i</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each biomass-blended fuel "i" (metric tons).

Product<sub>p</sub> = Annual volume of the petroleum-based portion of each biomass blended fuel "i" produced by the refiner (barrels).

EF<sub>i</sub> = Petroleum product-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel).

**(4) Calculation Method 2 procedures for non-crude feedstocks.**

- (i) A refiner using Calculation Method 2 of this subpart to determine the emission factor of a non-crude petroleum feedstock that does not contain denatured ethanol must calculate the CO<sub>2</sub> emissions associated with that feedstock using Equation MM-11 of this section in place of Equation MM-2 of this section.

$$CO_{2j} = (Feedstock_j \cdot EF_j) - (Feedstock_j \cdot EF_m \cdot \%Vol_m) \quad (\text{Eq. MM-11})$$

where:

CO<sub>2j</sub> = Annual CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of each non-crude feedstock "j" (metric tons).

Feedstock<sub>j</sub> = Annual volume of each petroleum product "j" that enters the refinery to be further refined or otherwise used on site (barrels).

EF<sub>j</sub> = Feedstock-specific CO<sub>2</sub> emission factor (metric tons CO<sub>2</sub> per barrel).

EF<sub>m</sub> = Default CO<sub>2</sub> emission factor from Table MM-2 to subpart MM that most closely represents the component of petroleum product "j" that is biomass-based.

%Vol<sub>m</sub> = Percent volume of non-crude feedstock "j" that is biomass-based, expressed as a fraction (e.g., 75% would be expressed as 0.75 in the above equation).

- (ii) In the event that a non-crude feedstock contains denatured ethanol, refiners must follow Calculation Method 1 procedures in paragraph (h)(2) of this section.

- (i) *Optional procedures for blended products that do not contain biomass.*



- (1) In the event that a reporter produces, imports, or exports a blended product that does not include biomass, the reporter may calculate emissions for the blended product according to the method in paragraph (i)(2) of this section. In the event that a refiner receives a blended non-crude feedstock that does not include biomass, the refiner may calculate emission for the blended non-crude feedstock according to the method in paragraph (i)(3) of this section. The procedures in this section may be used only if all of the following criteria are met:
  - (i) The reporter knows the relative proportion of each component of the blend (i.e., the mass or volume percentage).
  - (ii) Each component of blended product "i" or blended non-crude feedstock "j" meets the strict definition of a product listed in Table MM-1 to subpart MM.
  - (iii) The blended product or non-crude feedstock is not comprised entirely of natural gas liquids.
  - (iv) The reporter uses Calculation Method 1.
  - (v) Solid components are blended only with other solid components.
- (2) The reporter must calculate emissions for the blended product using Equation MM-12 of this section in place of Equation MM-1 of this section.

$$CO_{2i} = \sum [ \text{Blending Component}_{i...n} * EF_{i...n} ] \quad (\text{Eq. MM-12})$$

where:

$CO_{2i}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of a blended product "i" (metric tons).

$\text{Blending Component}_{i...n}$  = Annual volume or mass of each blending component that is blended (barrels or metric tons).

$EF_{i...n}$  =  $CO_2$  emission factors specific to each blending component (metric tons  $CO_2$  per barrel or per metric ton of product).

n = Number of blending components blended into blended product "i".

- (3) For refineries, the reporter must calculate emissions for the blended non-crude feedstock using Equation MM-13 of this section in place of Equation MM-2 of this section.

$$CO_{2j} = \sum [ \text{Blending Component}_{j...n} * EF_{j...n} ] \quad (\text{Eq. MM-13})$$

where:

$CO_{2j}$  = Annual  $CO_2$  emissions that would result from the complete combustion or oxidation of a blended non-crude feedstock "j" (metric tons).

$\text{Blending Component}_{j...n}$  = Annual volume or mass of each blending component that is blended (barrels or metric tons).



$EF_{i...n}$  = CO<sub>2</sub> emission factors specific to each blending component (metric tons CO<sub>2</sub> per barrel or per metric ton of product).

n = Number of blending components blended into blended non-crude feedstock "j".

- (4) For refineries, if a blending component "k" used in paragraph (i)(2) of this section enters the refinery before blending as non-crude feedstock:
  - (i) The emissions that would result from the complete combustion or oxidation of non-crude feedstock "k" must still be calculated separately using Equation MM-2 of this section and applied in Equation MM-4 of this section.
  - (ii) The quantity of blending component "k" applied in Equation MM-12 of this section and the quantity of non-crude feedstock "k" applied in Equation MM-2 of this section must be determined using the same method or practice.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66475, Oct. 28, 2010; 78 FR 71973, Nov. 29, 2013]

## § 98.394 Monitoring and QA/QC requirements.

### (a) *Determination of quantity.*

- (1) The quantity of petroleum products, natural gas liquids, and biomass, shall be determined as follows:
  - (i) Where an appropriate standard method published by a consensus-based standards organization exists, such a method shall be used. Consensus-based standards organizations include, but are not limited to, the following: ASTM International, the American National Standards Institute (ANSI), the American Gas Association (AGA), the American Society of Mechanical Engineers (ASME), the American Petroleum Institute (API), and the North American Energy Standards Board (NAESB).
  - (ii) Where no appropriate standard method developed by a consensus-based standards organization exists, industry standard practices shall be followed.
  - (iii) For products that are liquid at 60 degrees Fahrenheit and one standard atmosphere, all measurements of quantity shall be temperature-adjusted and pressure-adjusted to these conditions. For all other products, reporters shall use appropriate standard conditions specified in the standard method; if temperature and pressure conditions are not specified in the standard method or if a reporter uses an industry standard practice to determine quantity, the reporter shall use appropriate standard conditions according to established industry practices.
- (2) All measurement equipment (including, but not limited to, flow meters and tank gauges) used for compliance with this subpart shall be appropriate for the standard method or industry standard practice followed under paragraph (a)(1)(i) or (a)(1)(ii) of this section.
- (3) The annual quantity of crude oil received shall be determined according to one of the following methods. You may use an appropriate standard method published by a consensus-based standards organization or you may use an industry standard practice.

### (b) *Equipment Calibration.*

- (1) All measurement equipment shall be calibrated prior to its first use for reporting under this subpart, using an appropriate standard method published by a consensus based standards organization or according to the equipment manufacturer's directions.
- (2) Measurement equipment shall be recalibrated at the minimum frequency specified by the standard method used or by the equipment manufacturer's directions.
- (3) For units and processes that operate continuously with infrequent outages, it may not be possible to complete the calibration of a flow meter or other measurement device without disrupting normal process operation. In such cases, the owner or operator may postpone the calibration until the next scheduled maintenance outage. The best available information from company records may be used in the interim. Such postponements shall be documented in the monitoring plan that is required under § 98.3(g)(5).

(c) *Procedures for Calculation Method 2 of this subpart.*

- (1) Reporting parties shall collect one sample of each petroleum product or natural gas liquid on any day of each calendar month of the reporting year in which the quantity of that product was measured in accordance with the requirements of this subpart. For example, if a given product was measured as entering the refinery continuously throughout the reporting year, twelve samples of that product shall be collected over the reporting year, one on any day of each calendar month of that year. If a given product was only measured from April 15 through June 10 of the reporting year, a refiner would collect three samples during that year, one during each of the calendar months of April, May and June on a day when the product was measured as either entering or exiting the refinery. Each sample shall be collected using an appropriate standard method published by a consensus-based standards organization.
- (2) Mixing and handling of samples shall be performed using an appropriate standard method published by a consensus-based standards organization.
- (3) Density measurement.
  - (i) For all products that are not solid, reporters shall test for density using an appropriate standard method published by a consensus-based standards organization.
  - (ii) The density value for a given petroleum product shall be generated by either making a physical composite of all of the samples collected for the reporting year and testing that single sample or by measuring the individual samples throughout the year and defining the representative density value for the sample set by numerical means, i.e., a mathematical composite. If a physical composite is chosen as the option to obtain the density value, the reporter shall submit each of the individual samples collected during the reporting year to the laboratory responsible for generating the composite sample.
  - (iii) For physical composites, the reporter shall handle the individual samples and the laboratory shall mix them in accordance with an appropriate standard method published by a consensus-based standards organization.
  - (iv) All measurements of density shall be temperature-adjusted and pressure-adjusted to the conditions assumed for determining the quantities of the product reported under this subpart.
- (4) Carbon share measurement.

- (i) Reporters shall test for carbon share using an appropriate standard method published by a consensus-based standards organization.
- (ii) If a standard method that involves gas chromatography is used to determine the percent mass of each component in a product, the molecular formula for each component shall be obtained from the information provided in the standard method and the atomic mass of each element in a given molecular component shall be obtained from the periodic table of the elements.
- (iii) The carbon share value for a given petroleum product shall be generated by either making a physical composite of all of the samples collected for the reporting year and testing that single sample or by measuring the individual samples throughout the year and defining the representative carbon share value for the sample set by numerical means, i.e., a mathematical composite. If a physical composite is chosen as the option to obtain the carbon share value, the reporter shall submit each of the individual samples collected during the reporting year to the laboratory responsible for generating the composite sample.
- (iv) For physical composites, the reporter shall handle the individual samples and the laboratory shall mix them in accordance with an appropriate standard method published by a consensus-based standards organization.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66477, Oct. 28, 2010; 78 FR 71972, Nov. 29, 2013]

#### § 98.395 Procedures for estimating missing data.

- (a) **Determination of quantity.** Whenever the quality assurance procedures in § 98.394(a) cannot be followed to measure the quantity of one or more petroleum products, natural gas liquids, types of biomass, feedstocks, or crude oil during any period (e.g., if a meter malfunctions), the following missing data procedures shall be used:
  - (1) For quantities of a product that are purchased or sold, a period of missing data shall be substituted using a reporter's established procedures for billing purposes in that period as agreed to by the party selling or purchasing the product.
  - (2) For quantities of a product that are not purchased or sold but of which the custody is transferred, a period of missing data shall be substituted using a reporter's established procedures for tracking purposes in that period as agreed to by the party involved in custody transfer of the product.
- (b) **Determination of emission factor.** Whenever any of the procedures in § 98.394(c) cannot be followed to develop an emission factor for any reason, Calculation Method 1 of this subpart must be used in place of Calculation Method 2 of this subpart for the entire reporting year.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71973, Nov. 29, 2013; 81 FR 89268, Dec. 9, 2016]

#### § 98.396 Data reporting requirements.

In addition to the information required by § 98.3(c), the following requirements apply:

- (a) Refiners shall report the following information for each facility:
  - (1) [Reserved]

- (2) For each petroleum product or natural gas liquid listed in Table MM-1 of this subpart that enters the refinery to be further refined or otherwise used on site, report the annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product.
- (3) For each feedstock reported in paragraph (a)(2) of this section that was produced by blending a petroleum-based product with a biomass-based product, report the percent of the volume reported in paragraph (a)(2) of this section that is petroleum-based (excluding any denaturant that may be present in any ethanol product).
- (4)-(5) [Reserved]
- (6) For each petroleum product and natural gas liquid (ex refinery gate) listed in Table MM-1 of this subpart, report the annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product. Petroleum products and natural gas liquids that enter the refinery, but are not reported in (a)(2), shall not be reported under this paragraph.
- (7) For each product reported in paragraph (a)(6) of this section that was produced by blending a petroleum-based product with a biomass-based product, report the percent of the volume reported in paragraph (a)(6) of this section that is petroleum-based (excluding any denaturant that may be present in any ethanol product).
- (8) [Reserved]
- (9) For every feedstock reported in paragraph (a)(2) of this section for which Calculation Method 2 of this subpart was used to determine an emissions factor, report:
  - (i) The number of samples collected according to § 98.394(c)
  - (ii) The sampling standard method used.
  - (iii) The carbon share test results in percent mass.
  - (iv) The standard method used to test carbon share.
  - (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or per metric ton of product.
- (10) For every non-solid feedstock reported in paragraph (a)(2) of this section for which Calculation Method 2 of this subpart was used to determine an emissions factor, report:
  - (i) The density test results in metric tons per barrel.
  - (ii) The standard method used to test density.
- (11) For every petroleum product and natural gas liquid reported in paragraph (a)(6) of this section for which Calculation Method 2 of this subpart was used to determine an emissions factor, report:
  - (i) The number of samples collected according to § 98.394(c).
  - (ii) The sampling standard method used.
  - (iii) The carbon share test results in percent mass.
  - (iv) The standard method used to test carbon share.
  - (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or per metric ton of product.
- (12) For every non-solid petroleum product and natural gas liquid reported in paragraph (a)(6) for which Calculation Method 2 was used to determine an emissions factor, report:

- (i) The density test results in metric tons per barrel.
  - (ii) The standard method used to test density.
- (13) [Reserved]
- (14) For each specific type of biomass that enters the refinery to be co-processed with petroleum feedstocks to produce a petroleum product reported in paragraph (a)(6) of this section, report the annual quantity in metric tons or barrels.
- (15) [Reserved]
- (16) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each petroleum product and natural gas liquid (ex refinery gate) reported in paragraph (a)(6) of this section that were calculated according to § 98.393(a) or (h).
- (17) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each feedstock reported in paragraph (a)(2) of this section that were calculated according to § 98.393(b) or (h).
- (18) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each type of biomass feedstock co-processed with petroleum feedstocks reported in paragraph (a)(14) of this section, calculated according to § 98.393(c).
- (19) The sum of CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of all products, calculated according to § 98.393(d).
- (20) For all crude oil that enters the refinery, report the annual quantity in barrels.
- (21) The quantity of bulk NGLs in metric tons or barrels received for processing during the reporting year. Report only quantities of bulk NGLs not reported in (a)(2) of this section.
- (22) Volume of crude oil in barrels that you injected into a crude oil supply or reservoir.
- (b) In addition to the information required by § 98.3(c), each importer shall report all of the following information at the corporate level:
  - (1) [Reserved]
  - (2) For each petroleum product and natural gas liquid listed in Table MM-1 of this subpart, report the annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product.
  - (3) For each product reported in paragraph (b)(2) of this section that was produced by blending a petroleum-based product with a biomass-based product, report the percent of the volume reported in paragraph (b)(2) of this section that is petroleum-based (excluding any denaturant that may be present in any ethanol product).
  - (4) [Reserved]
  - (5) For each product reported in paragraph (b)(2) of this section for which Calculation Method 2 of this subpart used was used to determine an emissions factor, report:
    - (i) The number of samples collected according to § 98.394(c).
    - (ii) The sampling standard method used.

- (iii) The carbon share test results in percent mass.
  - (iv) The standard method used to test carbon share.
  - (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or per metric ton of product.
- (6) For each non-solid product reported in paragraph (b)(2) of this section for which Calculation Method 2 of this subpart was used to determine an emissions factor, report:
  - (i) The density test results in metric tons per barrel.
  - (ii) The standard method used to test density.
- (7) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each imported petroleum product and natural gas liquid reported in paragraph (b)(2) of this section, calculated according to § 98.393(a).
- (8) The sum of CO<sub>2</sub> emissions that would result from the complete combustion oxidation of all imported products, calculated according to § 98.393(e).
- (c) In addition to the information required by § 98.3(c), each exporter shall report all of the following information at the corporate level:
  - (1) [Reserved]
  - (2) For each petroleum product and natural gas liquid listed in Table MM-1 of this subpart, report the annual quantity in metric tons or barrels. For natural gas liquids, quantity shall reflect the individual components of the product.
  - (3) For each product reported in paragraph (c)(2) of this section that was produced by blending a petroleum-based product with a biomass-based product, report the percent of the volume reported in paragraph (c)(2) of this section that is petroleum based (excluding any denaturant that may be present in any ethanol product).
  - (4) [Reserved]
  - (5) For each product reported in paragraph (c)(2) of this section for which Calculation Method 2 of this subpart was used to determine an emissions factor, report:
    - (i) The number of samples collected according to § 98.394(c).
    - (ii) The sampling standard method used.
    - (iii) The carbon share test results in percentmass.
    - (iv) The standard method used to test carbon share.
    - (v) The calculated CO<sub>2</sub> emissions factor in metric tons CO<sub>2</sub> per barrel or per metric ton of product.
  - (6) For each non-solid product reported in paragraph (c)(2) of this section for which Calculation Method 2 of this subpart used was used to determine an emissions factor, report:
    - (i) The density test results in metric tons per barrel.
    - (ii) The standard method used to test density.

(7) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of for each exported petroleum product and natural gas liquid reported in paragraph (c)(2) of this section, calculated according to § 98.393(a).

(8) The sum of CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of all exported products, calculated according to § 98.393(e).

(d) **Blended non-crude feedstock and products.**

(1) Refineries, exporters, and importers must report the following information for each blended product and non-crude feedstock where emissions were calculated according to § 98.393(i):

(i) Volume or mass of each blending component.

(ii) The CO<sub>2</sub> emissions in metric tons that would result from the complete combustion or oxidation of each blended non-crude feedstock or product, using Equation MM-12 or Equation MM-13 of this section.

(iii) Whether it is a blended non-crude feedstock or a blended product.

(2) For a product that enters the refinery to be further refined or otherwise used on site that is a blended non-crude feedstock, refiners must meet the reporting requirements of paragraph (a)(2) of this section by reflecting the individual components of the blended non-crude feedstock.

(3) For a product that is produced, imported, or exported that is a blended product, refiners, importers, and exporters must meet the reporting requirements of paragraphs (a)(6), (b)(2), and (c)(2) of this section, as applicable, by reflecting the individual components of the blended product.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66477, Oct. 28, 2010; 78 FR 71973, Nov. 29, 2013]

**§ 98.397 Records that must be retained.**

(a) All reporters shall retain copies of all reports submitted to EPA under § 98.396. In addition, all reporters shall maintain sufficient records to support information contained in those reports, including but not limited to information on the characteristics of their feedstocks and products.

(b) Reporters shall maintain records to support quantities that are reported under this subpart, including records documenting any estimations of missing data and the number of calendar days in the reporting year for which substitute data procedures were followed. For all reported quantities of petroleum products, natural gas liquids, and biomass, reporters shall maintain metering, gauging, and other records normally maintained in the course of business to document product and feedstock flows including the date of initial calibration and the frequency of recalibration for the measurement equipment used.

(c) Reporters shall retain laboratory reports, calculations and worksheets used to estimate the CO<sub>2</sub> emissions of the quantities of petroleum products, natural gas liquids, biomass, and feedstocks reported under this subpart.

(d) Reporters shall maintain laboratory reports, calculations and worksheets used in the measurement of density and carbon share for any petroleum product or natural gas liquid for which CO<sub>2</sub> emissions were calculated using Calculation Method 2.

(e) Estimates of missing data shall be documented and records maintained showing the calculations.

(f) Reporters described in this subpart shall also retain all records described in § 98.3(g).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66478, Oct. 28, 2010; 78 FR 71974, Nov. 29, 2013]

## § 98.398 Definitions.

Except as specified in this section, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Bulk NGLs** for purposes of reporting under this subpart means mixtures of NGLs that are sold or delivered as undifferentiated product.

**Natural Gas Liquids (NGLs)** for the purposes of reporting under this subpart means hydrocarbons that are separated from natural gas as liquids through the process of absorption, condensation, adsorption, or other methods, and are sold or delivered as differentiated product. Generally, such liquids consist of ethane, propane, butanes, or pentanes plus.

[75 FR 66478, Oct. 28, 2010, as amended at 78 FR 71974, Nov. 29, 2013]

**Table MM-1 to Subpart MM of Part 98—Default Factors for Petroleum Products and Natural Gas Liquids<sup>12</sup>**

| Products                | Column A: density<br>(metric tons/bbl) | Column B:<br>carbon share<br>(% of mass) | Column C:<br>emission factor<br>(metric tons CO <sub>2</sub> /bbl) |
|-------------------------|----------------------------------------|------------------------------------------|--------------------------------------------------------------------|
| FINISHED MOTOR GASOLINE |                                        |                                          |                                                                    |
| Conventional—Summer     |                                        |                                          |                                                                    |
| Regular                 | 0.1181                                 | 86.66                                    | 0.3753                                                             |
| Midgrade                | 0.1183                                 | 86.63                                    | 0.3758                                                             |
| Premium                 | 0.1185                                 | 86.61                                    | 0.3763                                                             |
| Conventional—Winter     |                                        |                                          |                                                                    |
| Regular                 | 0.1155                                 | 86.50                                    | 0.3663                                                             |
| Midgrade                | 0.1161                                 | 86.55                                    | 0.3684                                                             |
| Premium                 | 0.1167                                 | 86.59                                    | 0.3705                                                             |
| Reformulated—Summer     |                                        |                                          |                                                                    |
| Regular                 | 0.1167                                 | 86.13                                    | 0.3686                                                             |

<sup>1</sup> In the case of products blended with some portion of biomass-based fuel, the carbon share in Table MM-1 of this subpart represents only the petroleum-based components.

<sup>2</sup> Products that are derived entirely from biomass should not be reported, but products that were derived from both biomass and a petroleum product (i.e., co-processed) should be reported as the petroleum product that it most closely represents.

<sup>3</sup> The density and emission factors for components of LPG determined at 60 degrees Fahrenheit and saturation pressure (LPGs other than ethylene).

<sup>4</sup> The density and emission factor for ethylene determined at 41 degrees Fahrenheit and saturation pressure.



| Products            | Column A: density<br>(metric tons/bbl) | Column B:<br>carbon share<br>(% of mass) | Column C:<br>emission factor<br>(metric tons CO <sub>2</sub> /bbl) |
|---------------------|----------------------------------------|------------------------------------------|--------------------------------------------------------------------|
| Midgrade            | 0.1165                                 | 86.07                                    | 0.3677                                                             |
| Premium             | 0.1164                                 | 86.00                                    | 0.3670                                                             |
| Reformulated—Winter |                                        |                                          |                                                                    |
| Regular             | 0.1165                                 | 86.05                                    | 0.3676                                                             |
| Midgrade            | 0.1165                                 | 86.06                                    | 0.3676                                                             |
| Premium             | 0.1166                                 | 86.06                                    | 0.3679                                                             |
| Gasoline—Other      | 0.1185                                 | 86.61                                    | 0.3763                                                             |
| BLENDSTOCKS         |                                        |                                          |                                                                    |
| CBOB—Summer         |                                        |                                          |                                                                    |
| Regular             | 0.1181                                 | 86.66                                    | 0.3753                                                             |
| Midgrade            | 0.1183                                 | 86.63                                    | 0.3758                                                             |
| Premium             | 0.1185                                 | 86.61                                    | 0.3763                                                             |
| CBOB—Winter         |                                        |                                          |                                                                    |
| Regular             | 0.1155                                 | 86.50                                    | 0.3663                                                             |
| Midgrade            | 0.1161                                 | 86.55                                    | 0.3684                                                             |
| Premium             | 0.1167                                 | 86.59                                    | 0.3705                                                             |
| RBOB—Summer         |                                        |                                          |                                                                    |
| Regular             | 0.1167                                 | 86.13                                    | 0.3686                                                             |
| Midgrade            | 0.1165                                 | 86.07                                    | 0.3677                                                             |
| Premium             | 0.1164                                 | 86.00                                    | 0.3670                                                             |
| RBOB—Winter         |                                        |                                          |                                                                    |
| Regular             | 0.1165                                 | 86.05                                    | 0.3676                                                             |
| Midgrade            | 0.1165                                 | 86.06                                    | 0.3676                                                             |
| Premium             | 0.1166                                 | 86.06                                    | 0.3679                                                             |
| Blendstocks—Other   | 0.1185                                 | 86.61                                    | 0.3763                                                             |
| OXYGENATES          |                                        |                                          |                                                                    |
| Methanol            | 0.1268                                 | 37.48                                    | 0.1743                                                             |
| GTBA                | 0.1257                                 | 64.82                                    | 0.2988                                                             |
| MTBE                | 0.1181                                 | 68.13                                    | 0.2950                                                             |

<sup>1</sup> In the case of products blended with some portion of biomass-based fuel, the carbon share in Table MM-1 of this subpart represents only the petroleum-based components.

<sup>2</sup> Products that are derived entirely from biomass should not be reported, but products that were derived from both biomass and a petroleum product (i.e., co-processed) should be reported as the petroleum product that it most closely represents.

<sup>3</sup> The density and emission factors for components of LPG determined at 60 degrees Fahrenheit and saturation pressure (LPGs other than ethylene).

<sup>4</sup> The density and emission factor for ethylene determined at 41 degrees Fahrenheit and saturation pressure.

| Products                                         | Column A: density<br>(metric tons/bbl) | Column B:<br>carbon share<br>(% of mass) | Column C:<br>emission factor<br>(metric tons CO <sub>2</sub> /bbl) |
|--------------------------------------------------|----------------------------------------|------------------------------------------|--------------------------------------------------------------------|
| ETBE                                             | 0.1182                                 | 70.53                                    | 0.3057                                                             |
| TAME                                             | 0.1229                                 | 70.53                                    | 0.3178                                                             |
| DIPE                                             | 0.1156                                 | 70.53                                    | 0.2990                                                             |
| DISTILLATE FUEL OIL                              |                                        |                                          |                                                                    |
| Distillate No. 1                                 |                                        |                                          |                                                                    |
| Ultra Low Sulfur                                 | 0.1346                                 | 86.40                                    | 0.4264                                                             |
| Low Sulfur                                       | 0.1346                                 | 86.40                                    | 0.4264                                                             |
| High Sulfur                                      | 0.1346                                 | 86.40                                    | 0.4264                                                             |
| Distillate No. 2                                 |                                        |                                          |                                                                    |
| Ultra Low Sulfur                                 | 0.1342                                 | 87.30                                    | 0.4296                                                             |
| Low Sulfur                                       | 0.1342                                 | 87.30                                    | 0.4296                                                             |
| High Sulfur                                      | 0.1342                                 | 87.30                                    | 0.4296                                                             |
| Distillate Fuel Oil No. 4                        | 0.1452                                 | 86.47                                    | 0.4604                                                             |
| Residual Fuel Oil No. 5 (Navy Special)           | 0.1365                                 | 85.67                                    | 0.4288                                                             |
| Residual Fuel Oil No. 6 (a.k.a. Bunker C)        | 0.1528                                 | 84.67                                    | 0.4744                                                             |
| Kerosene-Type Jet Fuel                           | 0.1294                                 | 86.30                                    | 0.4095                                                             |
| Kerosene                                         | 0.1346                                 | 86.40                                    | 0.4264                                                             |
| Diesel—Other                                     | 0.1452                                 | 86.47                                    | 0.4604                                                             |
| PETROCHEMICAL FEEDSTOCKS                         |                                        |                                          |                                                                    |
| Naphthas (<401 °F)                               | 0.1158                                 | 84.11                                    | 0.3571                                                             |
| Other Oils (>401 °F)                             | 0.1390                                 | 87.30                                    | 0.4450                                                             |
| UNFINISHED OILS                                  |                                        |                                          |                                                                    |
| Heavy Gas Oils                                   | 0.1476                                 | 85.80                                    | 0.4643                                                             |
| Residuum                                         | 0.1622                                 | 85.70                                    | 0.5097                                                             |
| OTHER PETROLEUM PRODUCTS AND NATURAL GAS LIQUIDS |                                        |                                          |                                                                    |
| Aviation Gasoline                                | 0.1120                                 | 85.00                                    | 0.3490                                                             |
| Special Naphthas                                 | 0.1222                                 | 84.76                                    | 0.3798                                                             |
| Lubricants                                       | 0.1428                                 | 85.80                                    | 0.4492                                                             |
| Waxes                                            | 0.1285                                 | 85.30                                    | 0.4019                                                             |

<sup>1</sup> In the case of products blended with some portion of biomass-based fuel, the carbon share in Table MM-1 of this subpart represents only the petroleum-based components.

<sup>2</sup> Products that are derived entirely from biomass should not be reported, but products that were derived from both biomass and a petroleum product (i.e., co-processed) should be reported as the petroleum product that it most closely represents.

<sup>3</sup> The density and emission factors for components of LPG determined at 60 degrees Fahrenheit and saturation pressure (LPGs other than ethylene).

<sup>4</sup> The density and emission factor for ethylene determined at 41 degrees Fahrenheit and saturation pressure.

| Products                 | Column A: density<br>(metric tons/bbl) | Column B:<br>carbon share<br>(% of mass) | Column C:<br>emission factor<br>(metric tons CO <sub>2</sub> /bbl) |
|--------------------------|----------------------------------------|------------------------------------------|--------------------------------------------------------------------|
| Petroleum Coke           | 0.1818                                 | 92.28                                    | 0.6151                                                             |
| Asphalt and Road Oil     | 0.1634                                 | 83.47                                    | 0.5001                                                             |
| Still Gas                | 0.1405                                 | 77.70                                    | 0.4003                                                             |
| Ethane <sup>3</sup>      | 0.0579                                 | 79.89                                    | 0.170                                                              |
| Ethylene <sup>4</sup>    | 0.0492                                 | 85.63                                    | 0.154                                                              |
| Propane <sup>3</sup>     | 0.0806                                 | 81.71                                    | 0.241                                                              |
| Propylene <sup>3</sup>   | 0.0827                                 | 85.63                                    | 0.260                                                              |
| Butane <sup>3</sup>      | 0.0928                                 | 82.66                                    | 0.281                                                              |
| Butylene <sup>3</sup>    | 0.0972                                 | 85.63                                    | 0.305                                                              |
| Isobutane <sup>3</sup>   | 0.0892                                 | 82.66                                    | 0.270                                                              |
| Isobutylene <sup>3</sup> | 0.0949                                 | 85.63                                    | 0.298                                                              |
| Isobutylene              | 0.0936                                 | 85.63                                    | 0.2939                                                             |
| Pentanes Plus            | 0.1055                                 | 83.63                                    | 0.3235                                                             |
| Miscellaneous Products   | 0.1380                                 | 85.49                                    | 0.4326                                                             |

<sup>1</sup> In the case of products blended with some portion of biomass-based fuel, the carbon share in Table MM-1 of this subpart represents only the petroleum-based components.

<sup>2</sup> Products that are derived entirely from biomass should not be reported, but products that were derived from both biomass and a petroleum product (i.e., co-processed) should be reported as the petroleum product that it most closely represents.

<sup>3</sup> The density and emission factors for components of LPG determined at 60 degrees Fahrenheit and saturation pressure (LPGs other than ethylene).

<sup>4</sup> The density and emission factor for ethylene determined at 41 degrees Fahrenheit and saturation pressure.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71975, Nov. 29, 2013]

**Table MM-2 to Subpart MM of Part 98—Default Factors for Biomass-Based Fuels and Biomass**

| Biomass-based fuel and biomass | Column A:<br>Density<br>(metric tons/<br>bbl) | Column B: Carbon<br>share<br>(% of mass) | Column C:<br>Emission factor<br>(metric tons<br>CO <sub>2</sub> /bbl) |
|--------------------------------|-----------------------------------------------|------------------------------------------|-----------------------------------------------------------------------|
| Ethanol (100%)                 | 0.1267                                        | 52.14                                    | 0.2422                                                                |
| Biodiesel (100%, methyl ester) | 0.1396                                        | 77.30                                    | 0.3957                                                                |
| Rendered Animal Fat            | 0.1333                                        | 76.19                                    | 0.3724                                                                |
| Vegetable Oil                  | 0.1460                                        | 76.77                                    | 0.4110                                                                |

## Subpart NN—Suppliers of Natural Gas and Natural Gas Liquids

### § 98.400 Definition of the source category.

This supplier category consists of natural gas liquids fractionators and local natural gas distribution companies.

- (a) Natural gas liquids fractionators are installations that fractionate natural gas liquids (NGLs) into their constituent liquid products or mixtures of products (ethane, propane, normal butane, isobutane or pentanes plus) for supply to downstream facilities.
- (b) Local Distribution Companies (LDCs) are companies that own or operate distribution pipelines, not interstate pipelines or intrastate pipelines, that physically deliver natural gas to end users and that are within a single state that are regulated as separate operating companies by State public utility commissions or that operate as independent municipally-owned distribution systems. LDCs do not include pipelines (both interstate and intrastate) delivering natural gas directly to major industrial users and farm taps upstream of the local distribution company inlet.
- (c) This supply category does not consist of the following facilities:
  - (1) Field gathering and boosting stations.
  - (2) Natural gas processing plants that separate NGLs from natural gas and produce bulk or y-grade NGLs but do not fractionate these NGLs into their constituent products.
  - (3) Facilities that meet the definition of refineries and report under subpart MM of this part.
  - (4) Facilities that meet the definition of petrochemical plants and report under subpart X of this part.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71975, Nov. 29, 2013]

### § 98.401 Reporting threshold.

Any supplier of natural gas and natural gas liquids that meets the requirements of § 98.2(a)(4) must report GHG emissions associated with the products they supply.

[81 FR 89268, Dec. 9, 2016]

### § 98.402 GHGs to report.

- (a) NGL fractionators must report the CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the annual quantity of ethane, propane, normal butane, isobutane, and pentanes plus that is produced and sold or delivered to others.
- (b) LDCs must report the CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the annual volumes of natural gas provided to end-users on their distribution systems.

### § 98.403 Calculating GHG emissions.

- (a) LDCs and fractionators shall, for each individual product reported under this part, calculate the estimated CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the products supplied using either of Calculation Methodology 1 or 2 of this subpart:

- (1) **Calculation Methodology 1.** NGL fractionators shall estimate CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the product(s) supplied using Equation NN-1 of this section. The annual volume of each NGL product supplied (Fuel<sub>h</sub>) shall include any amount of that NGL supplied in a mixture or blend of two or more products listed in Tables NN-1 and NN-2 of this subpart. The annual volume of each NGL product supplied shall exclude any amount of that NGL contained in bulk NGLs exiting the facility (e.g., y-grade, o-grade, and other bulk NGLs). LDCs shall estimate CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the natural gas received at the city gate (including natural gas that is transported by, but not owned by, the reporter) using Equation NN-1 of this section. For each product, use the default value for higher heating value and CO<sub>2</sub> emission factor in Table NN-1 of this subpart. Alternatively, for each product, a reporter-specific higher heating value and CO<sub>2</sub> emission factor may be used, in place of one or both defaults provided they are developed using methods outlined in § 98.404. For each product, you must use the same volume unit throughout the equation.

$$CO_{2i} = 1 \times 10^{-3} \sum Fuel_h HHV_h EF_h \quad (\text{Eq. NN-1})$$

Where:

CO<sub>2i</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of each product "h" for redelivery to all recipients (metric tons).

Fuel<sub>h</sub> = Total annual volume of product "h" supplied (volume per year, in thousand standard cubic feet (Mscf) for natural gas and bbl for NGLs).

HHV<sub>h</sub> = Higher heating value of product "h" supplied (MMBtu/Mscf or MMBtu/bbl).

EF<sub>h</sub> = CO<sub>2</sub> emission factor of product "h" (kg CO<sub>2</sub>/MMBtu).

1 × 10<sup>-3</sup> = Conversion factor from kilograms to metric tons (MT/kg).

- (2) **Calculation Methodology 2.** NGL fractionators shall estimate CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the product(s) supplied using Equation NN-2 of this section. The annual volume of each NGL product supplied (Fuel<sub>h</sub>) shall include any amount of that NGL supplied in a mixture or blend of two or more products listed in Tables NN-1 and NN-2 of this subpart. The annual volume of each NGL product supplied shall exclude any amount of that NGL contained in bulk NGLs exiting the facility (e.g., y-grade, o-grade, and other bulk NGLs). LDCs shall estimate CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the natural gas received at the city gate (including natural gas that is transported by, but not owned by, the reporter) using Equation NN-2 of this section. For each product, use the default CO<sub>2</sub> emission factor found in Table NN-2 of this subpart. Alternatively, for each product, a reporter-specific CO<sub>2</sub> emission factor may be used in place of the default factor, provided it is developed using methods outlined in § 98.404. For each product, you must use the same volume unit throughout the equation.

$$CO_{2i} = \sum_h Fuel_h \cdot EF_h \quad (\text{Eq. NN-2})$$

Where:

$CO_{2i}$  = Annual  $CO_2$  mass emissions that would result from the combustion or oxidation of each product "h" (metric tons)

$Fuel_h$  = Total annual volume of product "h" supplied (volume per year, in Mscf for natural gas and bbl for NGLs).

$EF_h$  =  $CO_2$  emission factor of product "h" (MT  $CO_2$ /bbl, or MT  $CO_2$ /Mscf)

(b) Each LDC shall follow the procedures below.

- (1) For natural gas that is received for redelivery to downstream gas transmission pipelines and other local distribution companies, use Equation NN-3 of this section and the default values for the  $CO_2$  emission factors found in Table NN-2 of this subpart. Alternatively, reporter-specific  $CO_2$  emission factors may be used, provided they are developed using methods outlined in § 98.404.

$$CO_{2i} = Fuel \quad EF \quad (Eq. NN-3)$$

Where:

$CO_{2i}$  = Annual  $CO_2$  mass emissions that would result from the combustion or oxidation of natural gas for redelivery to transmission pipelines or other LDCs (metric tons).

$Fuel$  = Total annual volume of natural gas supplied to downstream gas transmission pipelines and other local distribution companies (Mscf per year).

$EF$  = Fuel-specific  $CO_2$  emission factor (MT  $CO_2$ /Mscf).

(2)

- (i) For natural gas delivered to large end-users, use Equation NN-4 of this section and the default values for the  $CO_2$  emission factors found in Table NN-2 of this subpart. A large end-user means any end-user facility receiving greater than or equal to 460,000 Mscf of natural gas per year. If the LDC does not know the total quantity of gas delivered to the end-user facility based on readily available information in the LDCs possession, then large end-user means any single meter at an end-user facility to which the LDC delivers equal to or greater than 460,000 Mscf per year.

- (ii) Alternatively, reporter-specific  $CO_2$  emission factors may be used, provided they are developed using methods outlined in § 98.404.

$$CO_{2k} = Fuel \quad EF \quad (Eq. NN-4)$$

Where:

$CO_{2k}$  = Annual  $CO_2$  mass emissions that would result from the combustion or oxidation of natural gas delivered to each large end-user k, as defined in paragraph (b)(2)(i) of this section (metric tons).

$Fuel$  = Total annual volume of natural gas supplied to each large end-user k, as defined in paragraph (b)(2)(i) of this section (Mscf per year).

EF = Fuel-specific CO<sub>2</sub> emission factor (MT CO<sub>2</sub>/Mscf).

- (3) For the net change in natural gas stored on system by the LDC during the reporting year, use Equation NN-5a of this section. For natural gas that is received by means other than through the city gate, and is not otherwise accounted for by Equation NN-1 or NN-2 of this section, use Equation NN-5b of this section.
- (i) For natural gas received by the LDC that is injected into on-system storage, and/or liquefied and stored, and for gas removed from storage and used for deliveries, use Equation NN-5a of this section and the default value for the CO<sub>2</sub> emission factors found in Table NN-2 of this subpart. Alternatively, a reporter-specific CO<sub>2</sub> emission factor may be used, provided it is developed using methods outlined in § 98.404.

$$CO_{2l} = [Fuel_1 - Fuel_2] * EF \quad (Eq. NN-5a)$$

Where:

CO<sub>2l</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of the net change in natural gas stored on system by the LDC within the reporting year (metric tons).

Fuel<sub>1</sub> = Total annual volume of natural gas added to storage on-system or liquefied and stored in the reporting year (Mscf per year).

Fuel<sub>2</sub> = Total annual volume of natural gas that is removed from storage or vaporized and removed from storage and used for deliveries to customers or other LDCs by the LDC within the reporting year (Mscf per year).

EF = CO<sub>2</sub> emission factor for natural gas placed into/removed from storage (MT CO<sub>2</sub>/Mscf).

- (ii) For natural gas received by the LDC that bypassed the city gate, use Equation NN-5b of this section. This includes natural gas received directly by LDC systems from producers or natural gas processing plants from local production, received as a liquid and vaporized for delivery, or received from any other source that bypassed the city gate. Use the default value for the CO<sub>2</sub> emission factors found in Table NN-2 of this subpart. Alternatively, a reporter-specific CO<sub>2</sub> emission factor may be used, provided it is developed using methods outlined in § 98.404.

$$CO_{2n} = Fuel_z * EF_z \quad (Eq. NN-5b)$$

Where:

CO<sub>2n</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of natural gas received that bypassed the city gate and is not otherwise accounted for by Equation NN-1 or NN-2 of this section (metric tons).

Fuel<sub>z</sub> = Total annual volume of natural gas received that was not otherwise accounted for by Equation NN-1 or NN-2 of this section (natural gas from producers and natural gas processing plants from local production, or natural gas that was received as a liquid, vaporized and delivered, and any other source that bypassed the city gate). (Mscf per year)

$EF_z$  = Fuel-specific CO<sub>2</sub> emission factor (MT CO<sub>2</sub>/Mscf)

- (4) Calculate the total CO<sub>2</sub> emissions that would result from the complete combustion or oxidation of the annual supply of natural gas to end-users that receive a supply less than 460,000 Mscf per year using Equation NN-6 of this section.

$$CO_2 = CO_{2i} + CO_{2n} - CO_{2j} - \sum CO_{2k} - CO_{2l} \quad (\text{Eq. NN-6})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of natural gas delivered to LDC end-users not covered in paragraph (b)(2) of this section (metric tons).

CO<sub>2i</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of natural gas received at the city gate as calculated in paragraph (a)(1) or (2) of this section (metric tons).

CO<sub>2j</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of natural gas delivered to transmission pipelines or other LDCs as calculated in paragraph (b)(1) of this section (metric tons).

CO<sub>2k</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of natural gas delivered to each large end-user as calculated in paragraph (b)(2) of this section (metric tons).

CO<sub>2l</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of the net change in natural gas stored by the LDC within the reported year as calculated in paragraph (b)(3)(i) of this section (metric tons).

CO<sub>2n</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of natural gas that was received by the LDC directly from sources bypassing the city gate, and is not otherwise accounted for in Equation NN-1 or NN-2 of this section, as calculated in paragraph (b)(3)(ii) of this section (metric tons).

- (c) Each NGL fractionator shall follow the following procedures.

(1)

- (i) For fractionated NGLs received by the reporter from other NGL fractionators, you shall use Equation NN-7 of this section and the default values for the CO<sub>2</sub> emission factors found in Table NN-2 of this subpart.
- (ii) Alternatively, reporter-specific CO<sub>2</sub> emission factors may be used, provided they are developed using methods outlined in § 98.404.

$$CO_{2m} = \sum_g F_{ue} I_g EF_g \quad (\text{Eq. NN-7})$$

Where:

CO<sub>2m</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of each fractionated NGL product "g" received from other fractionators (metric tons).



Fuel<sub>g</sub> = Total annual volume of each NGL product “g” received from other fractionators (bbls).

EF<sub>g</sub> = Fuel-specific CO<sub>2</sub> emission factor of NGL product “g” (MT CO<sub>2</sub>/bbl).

- (2) Calculate the total CO<sub>2</sub> equivalent emissions that would result from the combustion or oxidation of fractionated NGLs supplied less the quantity received from other fractionators using Equation NN-8 of this section.

$$CO_2 = CO_{2i} - CO_{2m} \quad (\text{Eq. NN-8})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of fractionated NGLs delivered to customers or on behalf of customers less the quantity received from other fractionators (metric tons).

CO<sub>2i</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of fractionated NGLs delivered to all customers or on behalf of customers as calculated in paragraph (a)(1) or (2) of this section (metric tons).

CO<sub>2m</sub> = Annual CO<sub>2</sub> mass emissions that would result from the combustion or oxidation of fractionated NGLs received from other fractionators and calculated in paragraph (c)(1) of this section (metric tons).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66478, Oct. 28, 2010; 78 FR 71975, Nov. 29, 2013; 81 FR 89268, Dec. 9, 2016]

## § 98.404 Monitoring and QA/QC requirements.

### (a) Determination of quantity.

- (1) NGL fractionators and LDCs shall determine the quantity of NGLs and natural gas using methods in common use in the industry for billing purposes as audited under existing Sarbanes Oxley regulation.
- (i) Where an appropriate standard method published by a consensus-based standards organization exists, such a method shall be used. Consensus-based standards organizations include, but are not limited to, the following: ASTM International, the American National Standards Institute (ANSI), the American Gas Association (AGA), the American Society of Mechanical Engineers (ASME), the American Petroleum Institute (API), and the North American Energy Standards Board (NAESB).
- (ii) Where no appropriate standard method developed by a consensus-based standards organization exists, industry standard practices shall be followed.
- (2) NGL fractionators and LDCs shall base the minimum frequency of the product quantity measurements, to be summed to the annual quantity reported, on the reporter's standard practices for commercial operations.
- (i) For NGL fractionators the minimum frequency of measurements shall be the measurements taken at custody transfers summed to the annual reportable volume.

- (ii) For natural gas the minimum frequency of measurement shall be based on the LDC's standard measurement schedules used for billing purposes and summed to the annual reportable volume.
- (3) NGL fractionators shall use measurement for NGLs at custody transfer meters or at such meters that are used to determine the NGL product slate delivered from the fractionation facility.
- (4) If a NGL fractionator supplies a product that is a mixture or blend of two or more products listed in Tables NN-1 and NN-2 of this subpart, the NGL fractionator shall report the quantities of the constituents of the mixtures or blends separately.
- (5) For an LDC using Equation NN-1 or NN-2 of this subpart, the point(s) of measurement for the natural gas volume received shall be the LDC city gate meter(s).
  - (i) If the LDC makes its own quantity measurements according to established business practices, its own measurements shall be used.
  - (ii) If the LDC does not make its own quantity measurements according to established business practices, it shall use its delivering pipeline invoiced measurements for natural gas deliveries to the LDC city gate, used in determining daily system sendout.
- (6) An LDC using Equation NN-3 of this subpart shall measure natural gas at the custody transfer meters.
- (7) An LDC using Equation NN-4 of this subpart shall measure natural gas at the large end-user's meter(s). Where a large end-user is known to have more than one meter located at their facility, based on readily available information in the LDCs possession, the reporter shall measure the natural gas at each meter and sum the annual volume delivered to all meters located at the end-user's facility to determine the total volume delivered to the large end-user. Otherwise, the reporter shall consider the total annual volume delivered through each single meter at a single particular location to be the volume delivered to an individual large end-user.
- (8) An LDC using Equation NN-5a and/or NN-5b of this subpart shall measure natural gas as follows:
  - (i) Fuel<sub>1</sub> shall be measured at the on-system storage injection meters and/or at the meters measuring natural gas to be liquefied.
  - (ii) Fuel<sub>2</sub> shall be measured at the meters used for measuring on-system storage withdrawals and/or LNG vaporization injection.
  - (iii) Fuel<sub>z</sub> shall be measured using established business practices.
- (9) An LDC shall measure all natural gas under the following standard industry temperature and pressure conditions: Cubic foot of gas at a temperature of 60 degrees Fahrenheit and at an absolute pressure of one atmosphere.

(b) **Determination of higher heating values (HHV).**

- (1) When a reporter uses the default HHV provided in this section to calculate Equation NN-1 of this subpart, the appropriate value shall be taken from Table NN-1 of this subpart.
- (2) When a reporter uses a reporter-specific HHV to calculate Equation NN-1 of this subpart, an appropriate standard test published by a consensus-based standards organization shall be used. Consensus-based standards organizations include, but are not limited to, the following: AGA and GPA.

- (i) If an LDC makes its own HHV measurements according to established business practices, then its own measurements shall be used.
- (ii) If an LDC does not make its own measurements according to established business practices, it shall use its delivering pipeline measurements.

(c) **Determination of emission factor (EF).**

- (1) When a reporter used the default EF provided in this section to calculate Equation NN-1 of this subpart, the appropriate value shall be taken from Table NN-1 of this subpart.
- (2) When a reporter used the default EF provided in this section to calculate Equation NN-2, NN-3, NN-4, NN-5a, NN-5b, or NN-7 of this subpart, the appropriate value shall be taken from Table NN-2 of this subpart.
- (3) When a reporter uses a reporter-specific EF, the reporter shall use an appropriate standard method published by a consensus-based standards organization to conduct compositional analysis necessary to determine reporter-specific CO<sub>2</sub> emission factors. Consensus-based standards organizations include, but are not limited to, the following: AGA and GPA.

(d) **Equipment Calibration.**

- (1) Equipment used to measure quantities in Equations NN-1, NN-2, NN-5a and NN-5b of this subpart shall be calibrated prior to its first use for reporting under this subpart, using a suitable standard method published by a consensus based standards organization or according to the equipment manufacturer's directions.
- (2) Equipment used to measure quantities in Equations NN-1, NN-2, NN-5a, and NN-5b of this subpart shall be recalibrated at the frequency specified by the standard method used or by the manufacturer's directions.
- (3) Equipment used to measure quantities in Equations NN-3 and NN-4 of this subpart shall be recalibrated at the frequency commonly used within the industry.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71976, Nov. 29, 2013; 81 FR 89269, Dec. 9, 2016]

**§ 98.405 Procedures for estimating missing data.**

- (a) Whenever a quality-assured value of the quantity of natural gas liquids or natural gas supplied during any period is unavailable (e.g., if a flow meter malfunctions), a substitute data value for the missing quantity measurement must be used in the calculations according to paragraphs (b) and (c) of this section.

(b) **Determination of quantity.**

- (1) NGL fractionators shall substitute meter records provided by pipeline(s) for all pipeline receipts of NGLs; by manifests for deliveries made to trucks or rail cars; or metered quantities accepted by the entities purchasing the output from the fractionator whether by pipeline or by truck or rail car. In cases where the metered data from the receiving pipeline(s) or purchasing entities are not available, fractionators may substitute estimates based on contract quantities required to be delivered under purchase or delivery contracts with other parties.
- (2) LDCs shall either substitute their delivering pipeline metered deliveries at the city gate or substitute nominations and scheduled delivery quantities for the period when metered values of actual deliveries are not available.

(c) **Determination of HHV and EF.**

- (1) Whenever an LDC that makes its own HHV measurements according to established business practices cannot follow the quality assurance procedures for developing a reporter-specific HHV, as specified in § 98.404, during any period for any reason, the reporter shall use either its delivering pipeline measurements or the default HHV provided in Table NN-1 of this part for that period.
- (2) Whenever an LDC that does not make its own HHV measurements according to established business practices or an NGL fractionator cannot follow the quality assurance procedures for developing a reporter-specific HHV, as specified in § 98.404, during any period for any reason, the reporter shall use the default HHV provided in Table NN-1 of this part for that period.
- (3) [Reserved]
- (4) Whenever a reporter cannot follow the quality assurance procedures for developing a reporter-specific EF, as specified in § 98.404, during any period for any reason, the reporter shall use the default EF provided in § 98.408 for that period.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71977, Nov. 29, 2013]

**§ 98.406 Data reporting requirements.**

- (a) In addition to the information required by § 98.3(c), the annual report for each NGL fractionator covered by this rule shall contain the following information.
  - (1) Annual quantity (in barrels) of each NGL product supplied (including fractionated NGL products received from other NGL fractionators) in the following product categories: Ethane, propane, normal butane, isobutane, and pentanes plus (Fuel<sub>h</sub> in Equations NN-1 and NN-2 of this subpart).
  - (2) Annual quantity (in barrels) of each NGL product received from other NGL fractionators in the following product categories: Ethane, propane, normal butane, isobutane, and pentanes plus (Fuel<sub>g</sub> in Equation NN-7 of this subpart).
  - (3) Annual volumes in Mscf of natural gas received for processing.
  - (4) Annual quantities (in barrels) of y-grade, o-grade, and other bulk NGLs:
    - (i) Received.
    - (ii) Supplied to downstream users.
  - (5) Annual quantity (in barrels) of propane that the NGL fractionator odorizes at the facility and delivers to others.
  - (6) Annual CO<sub>2</sub> emissions (metric tons) that would result from the complete combustion or oxidation of the quantities in paragraphs (a)(1) and (a)(2) of this section, calculated in accordance with § 98.403(a) and (c)(1).
  - (7) Annual CO<sub>2</sub> mass emissions (metric tons) that would result from the combustion or oxidation of fractionated NGLs supplied less the quantity received from other fractionators, calculated in accordance with § 98.403(c)(2). If the calculated value is negative, the reporter shall report the value as zero.
  - (8) The specific industry standard used to measure each quantity reported in paragraph (a)(1) of this section.

- (9) If the NGL fractionator developed reporter-specific EFs or HHVs, report the following for each product type:
  - (i) The specific industry standard(s) used to develop reporter-specific higher heating value(s) and/or emission factor(s), pursuant to § 98.404(b)(2) and (c)(3).
  - (ii) The developed HHV(s).
  - (iii) The developed EF(s).
- (b) In addition to the information required by § 98.3(c), the annual report for each LDC shall contain the following information.
  - (1) Annual volume in Mscf of natural gas received by the LDC at its city gate stations for redelivery on the LDC's distribution system, including for use by the LDC (Fuel<sub>h</sub> in Equations NN-1 and NN-2 of this subpart).
  - (2) Annual volume in Mscf of natural gas placed into storage or liquefied and stored (Fuel<sub>1</sub> in Equation NN-5a).
  - (3) Annual volume in Mscf of natural gas withdrawn from on-system storage and annual volume in Mscf of vaporized liquefied natural gas (LNG) withdrawn from storage for delivery on the distribution system (Fuel<sub>2</sub> in Equation NN-5a).
  - (4) [Reserved]
  - (5) Annual volume in Mscf of natural gas that bypassed the city gate(s) and was supplied through the LDC distribution system. This includes natural gas from producers and natural gas processing plants from local production, or natural gas that was vaporized upon receipt and delivered, and any other source that bypassed the city gate (Fuel<sub>z</sub> in Equation NN-5b).
  - (6) Annual volume in Mscf of natural gas delivered to downstream gas transmission pipelines and other local distribution companies (Fuel in Equation NN-3 of this subpart).
  - (7) Annual volume in Mscf of natural gas delivered by the LDC to each large end-user as defined in § 98.403(b)(2)(i) of this section.
  - (8) The total annual CO<sub>2</sub> mass emissions (metric tons) associated with the volumes in paragraphs (b)(1) through (b)(7) of this section, calculated in accordance with § 98.403(a) and (b)(1) through (b)(3).
  - (9) Annual CO<sub>2</sub> emissions (metric tons) that would result from the complete combustion or oxidation of the annual supply of natural gas to end-users registering less than 460,000 Mscf, calculated in accordance with § 98.403(b)(4). If the calculated value is negative, the reporter shall report the value as zero.
  - (10) The specific industry standard used to develop the volume reported in paragraph (b)(1) of this section.
  - (11) If the LDC developed reporter-specific EFs or HHVs, report the following:
    - (i) The specific industry standard(s) used to develop reporter-specific higher heating value(s) and/or emission factor(s), pursuant to § 98.404 (b)(2) and (c)(3).
    - (ii) The developed HHV(s).
    - (iii) The developed EF(s).

- (12) For each large end-user reported in paragraph (b)(7) of this section, report:
  - (i) The customer name, address, and meter number(s).
  - (ii) Whether the quantity of natural gas reported in paragraph (b)(7) of this section is the total quantity delivered to a large end-user's facility, or the quantity delivered to a specific meter located at the facility.
  - (iii) If known, report the EIA identification number of each LDC customer.
- (13) The annual volume in Mscf of natural gas delivered by the LDC (including natural gas that is not owned by the LDC) to each of the following end-use categories. For definitions of these categories, refer to EIA Form 176 (Annual Report of Natural Gas and Supplemental Gas Supply & Disposition) and Instructions.
  - (i) Residential consumers.
  - (ii) Commercial consumers.
  - (iii) Industrial consumers.
  - (iv) Electricity generating facilities.
- (14) The name of the U.S. state or territory covered in this report submission.
- (c) Each reporter shall report the number of days in the reporting year for which substitute data procedures were used for the following purpose:
  - (1) To measure quantity.
  - (2) To develop HHV(s).
  - (3) To develop EF(s).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66479, Oct. 28, 2010; 78 FR 71977, Nov. 29, 2013; 81 FR 89269, Dec. 9, 2016]

### **§ 98.407 Records that must be retained.**

In addition to the information required by § 98.3(g), the reporter shall retain the following records:

- (a) Records of all meter readings and documentation to support volumes of natural gas and NGLs that are reported under this part.
- (b) Records documenting any estimates of missing metered data and showing the calculations of the values used for the missing data.
- (c) Calculations and worksheets used to estimate CO<sub>2</sub> emissions for the volumes reported under this part.
- (d) Records related to the large end-users identified in § 98.406(b)(7).
- (e) Records relating to measured Btu content or carbon content showing specific industry standards used to develop reporter-specific higher heating values and emission factors.
- (f) Records of such audits as required by Sarbanes Oxley regulations on the accuracy of measurements of volumes of natural gas and NGLs delivered to customers or on behalf of customers.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 66479, Oct. 28, 2010]

## § 98.408 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

### Table NN-1 to Subpart NN of Part 98—Default Factors for Calculation Methodology 1 of This Subpart

| Fuel          | Default higher heating value <sup>1</sup> | Default CO2 emission factor<br>(kg CO2/MMBtu) |
|---------------|-------------------------------------------|-----------------------------------------------|
| Natural Gas   | 1.026 MMBtu/Mscf                          | 53.06                                         |
| Propane       | 3.84 MMBtu/bbl                            | 62.87                                         |
| Normal butane | 4.34 MMBtu/bbl                            | 64.77                                         |
| Ethane        | 2.85 MMBtu/bbl                            | 59.60                                         |
| Isobutane     | 4.16 MMBtu/bbl                            | 64.94                                         |
| Pentanes plus | 4.62 MMBtu/bbl                            | 70.02                                         |

<sup>1</sup> Conditions for higher heating values presented in MMBtu/bbl are 60 °F and saturation pressure.

[78 FR 71977, Nov. 29, 2013]

### Table NN-2 to Subpart NN of Part 98—Default Factors for Calculation Methodology 2 of This Subpart

| Fuel          | Unit   | Default CO2 emission factor<br>(MT CO2/Unit) <sup>1</sup> |
|---------------|--------|-----------------------------------------------------------|
| Natural Gas   | Mscf   | 0.0544                                                    |
| Propane       | Barrel | 0.241                                                     |
| Normal butane | Barrel | 0.281                                                     |
| Ethane        | Barrel | 0.170                                                     |
| Isobutane     | Barrel | 0.270                                                     |
| Pentanes plus | Barrel | 0.324                                                     |

<sup>1</sup> Conditions for emission value presented in MT CO2/bbl are 60 °F and saturation pressure.

[78 FR 71977, Nov. 29, 2013, as amended at 79 FR 3508, Jan. 22, 2014; 81 FR 89270, Dec. 9, 2016]

## Subpart OO—Suppliers of Industrial Greenhouse Gases

## § 98.410 Definition of the source category.

- (a) The industrial gas supplier source category consists of any facility that produces fluorinated GHGs or nitrous oxide; any bulk importer of fluorinated GHGs or nitrous oxide; and any bulk exporter of fluorinated GHGs or nitrous oxide. Starting with reporting year 2018, this source category also consists of any facility that produces fluorinated HTFs; any bulk importer of fluorinated HTFs; any bulk exporter of fluorinated HTFs; and any facility that destroys fluorinated GHGs or fluorinated HTFs.
- (b) To produce a fluorinated GHG means to manufacture a fluorinated GHG from any raw material or feedstock chemical. Producing a fluorinated GHG includes the manufacture of a fluorinated GHG as an isolated intermediate for use in a process that will result in its transformation either at or outside of the production facility. Producing a fluorinated GHG also includes the creation of a fluorinated GHG (with the exception of HFC-23) that is captured and shipped off site for any reason, including destruction. Producing a fluorinated GHG does not include the reuse or recycling of a fluorinated GHG, the creation of HFC-23 during the production of HCFC-22, the creation of intermediates that are created and transformed in a single process with no storage of the intermediates, or the creation of fluorinated GHGs that are released or destroyed at the production facility before the production measurement at § 98.414(a).
- (c) To produce nitrous oxide means to produce nitrous oxide by thermally decomposing ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ). Producing nitrous oxide does not include the reuse or recycling of nitrous oxide or the creation of by-products that are released or destroyed at the production facility.
- (d) To produce a fluorinated HTF means to manufacture, from any raw material or feedstock chemical, a fluorinated GHG used for temperature control, device testing, cleaning substrate surfaces and other parts, and soldering in processes including but not limited to certain types of electronics manufacturing production processes. Fluorinated heat transfer fluids do not include fluorinated GHGs used as lubricants or surfactants. For fluorinated heat transfer fluids under this subpart, the lower vapor pressure limit of 1 mm Hg in absolute at 25 °C in the definition of fluorinated greenhouse gas in § 98.6 shall not apply. Fluorinated heat transfer fluids include, but are not limited to, perfluoropolyethers, perfluoroalkanes, perfluoroethers, tertiary perfluoroamines, and perfluorocyclic ethers. Producing a fluorinated HTF does not include the reuse or recycling of a fluorinated HTF, the creation of intermediates, or the creation of fluorinated HTFs that are released or destroyed at the production facility before the production measurement at § 98.414(a).
- (e) For purposes of this subpart, to destroy fluorinated GHGs or fluorinated HTFs means to cause the expiration of a previously produced (as defined in paragraphs (b) and (d) of this section) fluorinated GHG or fluorinated HTF to the destruction efficiency actually achieved. Such destruction does not result in a commercially useful end product. For purposes of this subpart, such destruction does not include HFC-23 destruction as defined at § 98.150 or the dissociation of fluorinated GHGs that occurs during electronics manufacturing as defined at § 98.90. For example, such destruction does not include the dissociation of fluorinated GHGs that occurs during etch or chamber cleaning processes or during use of abatement systems that treat the fluorinated GHGs vented from such processes at electronics manufacturing facilities.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79167, Dec. 17, 2010; 81 FR 89270, Dec. 9, 2016]

## § 98.411 Reporting threshold.

Any supplier of industrial greenhouse gases who meets the requirements of § 98.2(a)(4) must report GHG emissions.



## § 98.412 GHGs to report.

You must report the GHG emissions that would result from the release of the nitrous oxide and each fluorinated GHG that you produce, import, export, transform, or destroy during the calendar year. Starting with reporting year 2018, you must also report the emissions that would result from the release of each fluorinated HTF that is not also a fluorinated GHG and that you produce, import, export, transform, or destroy during the calendar year.

[81 FR 89270, Dec. 9, 2016]

## § 98.413 Calculating GHG emissions.

- (a) Calculate the total mass of the nitrous oxide and each fluorinated GHG or fluorinated HTF produced annually, except for amounts that are captured solely to be shipped off site for destruction, by using Equation OO-1 of this section:

$$P = \sum_{p=1}^n P_p \quad (\text{Eq. OO-1})$$

P = Mass of fluorinated GHG, fluorinated HTF, or nitrous oxide produced annually.

$P_p$  = Mass of fluorinated GHG, fluorinated HTF, or nitrous oxide produced over the period "p".

- (b) Calculate the total mass of the nitrous oxide and each fluorinated GHG or fluorinated HTF produced over the period "p" by using Equation OO-2 of this section:

$$P_p = O_p - U_p \quad (\text{Eq. OO-2})$$

Where:

$P_p$  = Mass of fluorinated GHG, fluorinated HTF, or nitrous oxide produced over the period "p" (metric tons).

$O_p$  = Mass of fluorinated GHG, fluorinated HTF, or nitrous oxide that is measured coming out of the production process over the period p (metric tons).

$U_p$  = Mass of used fluorinated GHG, fluorinated HTF, or nitrous oxide that is added to the production process upstream of the output measurement over the period "p" (metric tons).

- (c) Calculate the total mass of the nitrous oxide and each fluorinated GHG or fluorinated HTF transformed by using Equation OO-3 of this section:

$$T = F_T \cdot E_T \quad (\text{Eq. OO-3})$$

Where:

T = Mass of fluorinated GHG, fluorinated HTF, or nitrous oxide transformed annually (metric tons).

$F_T$  = Mass of fluorinated GHG fed into the transformation process annually (metric tons).

$E_T$  = The fraction of the fluorinated GHG, fluorinated HTF, or nitrous oxide fed into the transformation process that is transformed in the process (metric tons).

- (d) Calculate the total mass of each fluorinated GHG or fluorinated HTF destroyed by using Equation OO-4 of this section:

$$D = F_D * DE \quad (\text{Eq. OO-4})$$

Where:

D = Mass of fluorinated GHG or fluorinated HTF destroyed annually (metric tons).

$F_D$  = Mass of fluorinated GHG or fluorinated HTF fed into the destruction device annually (metric tons).

DE = Destruction efficiency of the destruction device (fraction).

[74 FR 56374, Oct. 30, 2009, as amended at 81 FR 89270, Dec. 9, 2016]

### § 98.414 Monitoring and QA/QC requirements.

- (a) The mass of fluorinated GHGs, fluorinated HTFs, or nitrous oxide coming out of the production process shall be measured using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of one percent of full scale or better. If the measured mass includes more than one fluorinated GHG or fluorinated HTF, the concentrations of each of the fluorinated GHGs or fluorinated HTFs, other than low-concentration constituents, shall be measured as set forth in paragraph (n) of this section. For each fluorinated GHG or fluorinated HTF, the mean of the concentrations of that fluorinated GHG (mass fraction) measured under paragraph (n) shall be multiplied by the mass measurement to obtain the mass of that fluorinated GHG or fluorinated HTF coming out of the production process.
- (b) The mass of any used fluorinated GHGs, fluorinated HTFs, or used nitrous oxide added back into the production process upstream of the output measurement in paragraph (a) of this section shall be measured using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of one percent of full scale or better. If the mass in paragraph (a) is measured by weighing containers that include returned heels as well as newly produced fluorinated GHGs or fluorinated HTFs, the returned heels shall be considered used fluorinated GHGs or fluorinated HTFs for purposes of this paragraph (b) and § 98.413(b).
- (c) The mass of fluorinated GHGs, fluorinated HTFs, or nitrous oxide fed into the transformation process shall be measured using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of one percent of full scale or better.
- (d) The fraction of the fluorinated GHGs, fluorinated HTFs, or nitrous oxide fed into the transformation process that is actually transformed shall be estimated considering yield calculations or quantities of unreacted fluorinated GHGs, fluorinated HTFs, or nitrous oxide permanently removed from the process and recovered, destroyed, or emitted.
- (e) The mass of fluorinated GHGs, fluorinated HTFs, or nitrous oxide sent to another facility for transformation shall be measured using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of one percent of full scale or better.

- (f) The mass of fluorinated GHGs or fluorinated HTFs sent to another facility for destruction shall be measured using flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of one percent of full scale or better. If the measured mass includes more than trace concentrations of materials other than the fluorinated GHG or fluorinated HTF, the concentration of the fluorinated GHG or fluorinated HTF shall be estimated considering current or previous representative concentration measurements and other relevant process information. This concentration (mass fraction) shall be multiplied by the mass measurement to obtain the mass of the fluorinated GHG or fluorinated HTF sent to another facility for destruction.
- (g) You must estimate the share of the mass of fluorinated GHGs or fluorinated HTFs in paragraph (f) of this section that is comprised of fluorinated GHGs or fluorinated HTFs that are not included in the mass produced in § 98.413(a) because they are removed from the production process as by-products or other wastes.
- (h) You must measure the mass of each fluorinated GHG or fluorinated HTF that is fed into the destruction device and that was previously produced as defined at § 98.410(b). Such fluorinated GHGs or fluorinated HTFs include but are not limited to quantities that are shipped to the facility by another facility for destruction and quantities that are returned to the facility for reclamation but are found to be irretrievably contaminated and are therefore destroyed. You must use flowmeters, weigh scales, or a combination of volumetric and density measurements with an accuracy and precision of one percent of full scale or better. If the measured mass includes more than trace concentrations of materials other than the fluorinated GHG or fluorinated HTF being destroyed, you must estimate the concentrations of the fluorinated GHG or fluorinated HTF being destroyed considering current or previous representative concentration measurements and other relevant process information. You must multiply this concentration (mass fraction) by the mass measurement to obtain the mass of the fluorinated GHG or fluorinated HTF fed into the destruction device.
- (i) Very small quantities of fluorinated GHGs or fluorinated HTFs that are difficult to measure because they are entrained in other media such as destroyed filters and destroyed sample containers are exempt from paragraphs (f) and (h) of this section.
- (j) [Reserved]
- (k) For purposes of Equation OO-4 of this subpart, the destruction efficiency can be equated to the destruction efficiency determined during a previous performance test of the destruction device or, if no performance test has been done, the destruction efficiency provided by the manufacturer of the destruction device.
- (l) In their estimates of the mass of fluorinated GHGs or fluorinated HTFs destroyed, facilities that destroy fluorinated GHGs or fluorinated HTFs shall account for any temporary reductions in the destruction efficiency that result from any startups, shutdowns, or malfunctions of the destruction device, including departures from the operating conditions defined in state or local permitting requirements and/or oxidizer manufacturer specifications.
- (m) Calibrate all flow meters, weigh scales, and combinations of volumetric and density measures that are used to measure or calculate quantities that are to be reported under this subpart prior to the first year for which GHG emissions are reported under this part. Calibrations performed prior to the effective date of this rule satisfy this requirement. Recalibrate all flow meters, weigh scales, and combinations of volumetric and density measures at the minimum frequency specified by the manufacturer. Use NIST-traceable standards and suitable methods published by a consensus standards organization (e.g., ASTM, ASME, ISO, or others).

- (n) If the mass coming out of the production process includes more than one fluorinated GHG or fluorinated HTF, you shall measure the concentrations of all of the fluorinated GHGs or fluorinated HTFs, other than low-concentration constituents, as follows:
- (1) **Analytical Methods.** Use a quality-assured analytical measurement technology capable of detecting the analyte of interest at the concentration of interest and use a procedure validated with the analyte of interest at the concentration of interest. Where standards for the analyte are not available, a chemically similar surrogate may be used. Acceptable analytical measurement technologies include but are not limited to gas chromatography (GC) with an appropriate detector, infrared (IR), fourier transform infrared (FTIR), and nuclear magnetic resonance (NMR). Acceptable methods include EPA Method 18 in appendix A-1 of 40 CFR part 60; EPA Method 320 in appendix A of 40 CFR part 63; the Protocol for Measuring Destruction or Removal Efficiency (DRE) of Fluorinated Greenhouse Gas Abatement Equipment in Electronics Manufacturing, Version 1, EPA-430-R-10-003, (March 2010) (incorporated by reference, see § 98.7); ASTM D6348-03 Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy (incorporated by reference, see § 98.7); or other analytical methods validated using EPA Method 301 in appendix A of 40 CFR part 63 or some other scientifically sound validation protocol. The validation protocol may include analytical technology manufacturer specifications or recommendations.
  - (2) **Documentation in GHG Monitoring Plan.** Describe the analytical method(s) used under paragraph (n)(1) of this section in the site GHG Monitoring Plan as required under § 98.3(g)(5). At a minimum, include in the description of the method a description of the analytical measurement equipment and procedures, quantitative estimates of the method's accuracy and precision for the analytes of interest at the concentrations of interest, as well as a description of how these accuracies and precisions were estimated, including the validation protocol used.
  - (3) **Frequency of measurement.** Perform the measurements at least once by February 15, 2011 if the fluorinated GHG product is being produced on December 17, 2010. Perform the measurements within 60 days of commencing production of any fluorinated GHG product that was not being produced on December 17, 2010. For fluorinated HTF products that are not also fluorinated GHG products, perform the measurements at least once by February 28, 2018, if the fluorinated HTF product is being produced on January 1, 2018. Perform the measurements within 60 days of commencing production of any fluorinated HTF product that was not being produced on January 1, 2018. Repeat the measurements if an operational or process change occurs that could change the identities or significantly change the concentrations of the fluorinated GHG or fluorinated HTF constituents of the fluorinated GHG or fluorinated HTF product. Complete the repeat measurements within 60 days of the operational or process change.
  - (4) **Measure all product grades.** Where a fluorinated GHG or fluorinated HTF is produced at more than one purity level (e.g., pharmaceutical grade and refrigerant grade), perform the measurements for each purity level.
  - (5) **Number of samples.** Analyze a minimum of three samples of the fluorinated GHGs or fluorinated HTF product that have been drawn under conditions that are representative of the process producing the fluorinated GHGs or fluorinated HTF product. If the relative standard deviation of the measured concentrations of any of the fluorinated GHGs or fluorinated HTF constituents (other than low-concentration constituents) is greater than or equal to 15 percent, draw and analyze enough additional samples to achieve a total of at least six samples of the fluorinated GHG or fluorinated HTF product.

- (o) All analytical equipment used to determine the concentration of fluorinated GHGs or fluorinated HTFs, including but not limited to gas chromatographs and associated detectors, IR, FTIR and NMR devices, shall be calibrated at a frequency needed to support the type of analysis specified in the site GHG Monitoring Plan as required under paragraph (n) of this section and § 98.3(g)(5). Quality assurance samples at the concentrations of concern shall be used for the calibration. Such quality assurance samples shall consist of or be prepared from certified standards of the analytes of concern where available; if not available, calibration shall be performed by a method specified in the GHG Monitoring Plan.
- (p) Isolated intermediates that are produced and transformed at the same facility are exempt from the monitoring requirements of this section.
- (q) Low-concentration constituents are exempt from the monitoring and QA/QC requirements of this section.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79167, Dec. 17, 2010; 81 FR 89270, Dec. 9, 2016]

### § 98.415 Procedures for estimating missing data.

- (a) A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions), a substitute data value for the missing parameter shall be used in the calculations, according to paragraph (b) of this section.
- (b) For each missing value of the mass produced, fed into the production process (for used material being reclaimed), fed into the transformation process, fed into destruction devices, sent to another facility for transformation, or sent to another facility for destruction, the substitute value of that parameter shall be a secondary mass measurement where such a measurement is available. For example, if the mass produced is usually measured with a flowmeter at the inlet to the day tank and that flowmeter fails to meet an accuracy or precision test, malfunctions, or is rendered inoperable, then the mass produced may be estimated by calculating the change in volume in the day tank and multiplying it by the density of the product. Where a secondary mass measurement is not available, the substitute value of the parameter shall be an estimate based on a related parameter. For example, if a flowmeter measuring the mass fed into a destruction device is rendered inoperable, then the mass fed into the destruction device may be estimated using the production rate and the previously observed relationship between the production rate and the mass flow rate into the destruction device.

### § 98.416 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information:

- (a) Each fluorinated GHG, fluorinated HTF, or nitrous oxide production facility shall report the following information:
  - (1) Mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF produced at that facility by process, except for amounts that are captured solely to be shipped off site for destruction.
  - (2) Mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF transformed at that facility, by process.

- (3) Mass in metric tons of each fluorinated GHG or fluorinated HTF that is destroyed at that facility and that was previously produced as defined at § 98.410(b). Quantities to be reported under paragraph (a)(3) of this section include but are not limited to quantities that are shipped to the facility by another facility for destruction and quantities that are returned to the facility for reclamation but are found to be irretrievably contaminated and are therefore destroyed.
- (4) [Reserved]
- (5) Total mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF sent to another facility for transformation.
- (6) Total mass in metric tons of each fluorinated GHG or fluorinated HTF sent to another facility for destruction, except fluorinated GHGs and fluorinated HTFs that are not included in the mass produced in § 98.413(a) because they are removed from the production process as byproducts or other wastes. Quantities to be reported under paragraph (a)(6) of this section could include, for example, fluorinated GHGs that are returned to the facility for reclamation but are found to be irretrievably contaminated and are therefore sent to another facility for destruction.
- (7) Total mass in metric tons of each fluorinated GHG or fluorinated HTF that is sent to another facility for destruction and that is not included in the mass produced in § 98.413(a) because it is removed from the production process as a byproduct or other waste.
- (8)-(9) [Reserved]
- (10) Mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF fed into the transformation process, by process.
- (11) Mass in metric tons of each fluorinated GHG or fluorinated HTF that is fed into the destruction device and that was previously produced as defined at § 98.410(b). Quantities to be reported under paragraph (a)(11) of this section include but are not limited to quantities that are shipped to the facility by another facility for destruction and quantities that are returned to the facility for reclamation but are found to be irretrievably contaminated and are therefore destroyed.
- (12) Mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF that is measured coming out of the production process, by process.
- (13) Mass in metric tons of used nitrous oxide and of each used fluorinated GHG or fluorinated HTF added back into the production process (e.g., for reclamation), including returned heels in containers that are weighed to measure the mass in § 98.414(a), by process.
- (14) Names and addresses of facilities to which any nitrous oxide, fluorinated GHGs, or fluorinated HTFs were sent for transformation, and the quantities (metric tons) of nitrous oxide and of each fluorinated GHG or fluorinated HTF that were sent to each for transformation.
- (15) Names and addresses of facilities to which any fluorinated GHGs or fluorinated HTFs were sent for destruction, and the quantities (metric tons) of each fluorinated GHG or fluorinated HTF that were sent to each for destruction.
- (16) Where missing data have been estimated pursuant to § 98.415, the reason the data were missing, the length of time the data were missing, the method used to estimate the missing data, and the estimates of those data.

(b) Any facility or importer that destroys fluorinated GHGs or fluorinated HTFs shall submit a one-time report containing the information in paragraphs (b)(1) through (6) of this section for each destruction process by the applicable date set forth in paragraph (b)(7) of this section. Facilities and importers that previously submitted one-time reports under this paragraph for all destruction devices used to destroy fluorinated GHGs or fluorinated HTFs are exempt from this requirement unless they meet the conditions in paragraph (b)(6) of this section.

(1) Destruction efficiency (DE).

(2) Methods used to determine the destruction efficiency.

(3) Methods used to record the mass of fluorinated GHG or fluorinated HTF destroyed.

(4) Chemical identity of the fluorinated GHG(s) used in the performance test conducted to determine DE.

(5) Name of all applicable federal or state regulations that may apply to the destruction process.

(6) If any process changes (including the acquisition of a new destruction device) affect unit destruction efficiency or the methods used to record the mass of fluorinated GHG or fluorinated HTF destroyed, then a revised report must be submitted to reflect the changes. The revised report must be submitted to EPA within 60 days of the change.

(7)

(i) Any fluorinated GHG production facility or importer that destroys fluorinated GHGs must submit the one-time destruction report by March 31, 2011 or within 60 days of commencing fluorinated GHG destruction, whichever is later.

(ii) Any fluorinated GHG production facility or importer that destroys fluorinated HTFs that are not also fluorinated GHGs must submit the one-time destruction report by March 31, 2019 or within 60 days of commencing fluorinated HTF destruction, whichever is later.

(iii) Any facility that destroys fluorinated GHGs or fluorinated HTFs but does not produce or import fluorinated GHGs must submit the one-time destruction report by March 31, 2019 or within 60 days of commencing fluorinated GHG or fluorinated HTF destruction, whichever is later.

(c) Each bulk importer of fluorinated GHGs, fluorinated heat transfer fluids (HTFs), or nitrous oxide shall submit an annual report that summarizes its imports at the corporate level, except importers may exclude shipments including less than twenty-five kilograms of fluorinated GHGs, fluorinated HTFs, or nitrous oxide; transshipments if the importer also excludes transshipments from reporting of exports under paragraph (d) of this section; and heels that meet the conditions set forth at § 98.417(e) if the importer also excludes heels from any reporting of exports under paragraph (d) of this section. The report shall contain the following information for each import:

(1) Total mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF imported in bulk, including each fluorinated GHG or fluorinated HTF constituent of the fluorinated GHG or fluorinated HTF product that makes up between 0.5 percent and 100 percent of the product by mass.

(2) Total mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF imported in bulk and sold or transferred to persons other than the importer for use in processes resulting in the transformation or destruction of the chemical.

(3) Date on which the fluorinated GHGs, fluorinated HTFs, or nitrous oxide were imported.

- (4) Port of entry through which the fluorinated GHGs, fluorinated HTFs, or nitrous oxide passed.
  - (5) Country from which the imported fluorinated GHGs, fluorinated HTFs, or nitrous oxide were imported.
  - (6) Harmonized tariff system (HTS) code of the fluorinated GHGs, fluorinated HTFs, or nitrous oxide shipped.
  - (7) Customs entry number and importer number for each shipment.
  - (8) Total mass in metric tons of each fluorinated GHG or fluorinated HTF destroyed by the importer.
  - (9) If applicable, the names and addresses of the persons and facilities to which the nitrous oxide, fluorinated GHGs, or fluorinated HTFs were sold or transferred for transformation, and the quantities (metric tons) of nitrous oxide and of each fluorinated GHG or fluorinated HTF that were sold or transferred to each facility for transformation.
  - (10) If applicable, the names and addresses of the persons and facilities to which the fluorinated GHGs or fluorinated HTFs were sold or transferred for destruction, and the quantities (metric tons) of each fluorinated GHG or fluorinated HTF that were sold or transferred to each facility for destruction.
- (d) Each bulk exporter of fluorinated GHGs, fluorinated HTFs, or nitrous oxide shall submit an annual report that summarizes its exports at the corporate level, except reporters may exclude shipments including less than twenty-five kilograms of fluorinated GHGs, fluorinated HTFs, or nitrous oxide; transshipments if the exporter also excludes transshipments from reporting of imports under paragraph (c) of this section; and heels if the exporter also excludes heels from any reporting of imports under paragraph (c) of this section. The report shall contain the following information for each export:
- (1) Total mass in metric tons of nitrous oxide and each fluorinated GHG or fluorinated HTF exported in bulk.
  - (2) Names and addresses of the exporter and the recipient of the exports.
  - (3) Exporter's Employee Identification Number.
  - (4) Harmonized tariff system (HTS) code of the fluorinated GHGs, fluorinated HTFs, or nitrous oxide shipped.
  - (5) Date on which, and the port from which, the fluorinated GHGs, fluorinated HTFs, or nitrous oxide were exported from the United States or its territories.
  - (6) Country to which the fluorinated GHGs, fluorinated HTFs, or nitrous oxide were exported.
- (e) By March 31, 2011, or within 60 days of commencing fluorinated GHG production, whichever is later, a fluorinated GHG production facility shall submit a one-time report describing the following information:
- (1) The method(s) by which the producer in practice measures the mass of fluorinated GHGs produced, including the instrumentation used (Coriolis flowmeter, other flowmeter, weigh scale, etc.) and its accuracy and precision.
  - (2) The method(s) by which the producer in practice estimates the mass of fluorinated GHGs fed into the transformation process, including the instrumentation used (Coriolis flowmeter, other flowmeter, weigh scale, etc.) and its accuracy and precision.
  - (3) The method(s) by which the producer in practice estimates the fraction of fluorinated GHGs fed into the transformation process that is actually transformed, and the estimated precision and accuracy of this estimate.



- (4) The method(s) by which the producer in practice estimates the masses of fluorinated GHGs fed into the destruction device, including the method(s) used to estimate the concentration of the fluorinated GHGs in the destroyed material, and the estimated precision and accuracy of this estimate.
- (5) The estimated percent efficiency of each production process for the fluorinated GHG produced.
- (f) By March 31, 2011, all fluorinated GHG production facilities shall submit a one-time report that includes the concentration of each fluorinated GHG constituent in each fluorinated GHG product as measured under § 98.414(n). If the facility commences production of a fluorinated GHG product that was not included in the initial report or performs a repeat measurement under § 98.414(n) that shows that the identities or concentrations of the fluorinated GHG constituents of a fluorinated GHG product have changed, then the new or changed concentrations, as well as the date of the change, must be reflected in a revision to the report. The revised report must be submitted to EPA by the March 31st that immediately follows the measurement under § 98.414(n).
- (g) Isolated intermediates that are produced and transformed at the same facility are exempt from the reporting requirements of this section.
- (h) Low-concentration constituents are exempt from the reporting requirements of this section.
- (i) Each facility that destroys fluorinated GHGs or fluorinated HTFs but does not otherwise report under this section shall report the mass in metric tons of each fluorinated GHG or fluorinated HTF that is destroyed at that facility and that was previously produced as defined at § 98.410(b) or (d), as applicable. Quantities to be reported under this paragraph (i) include but are not limited to quantities that are shipped to the facility by another facility for destruction and quantities that are returned to the facility for reclamation but are found to be irretrievably contaminated and are therefore destroyed.
- (j) By March 31, 2019, all facilities that produce fluorinated HTFs that are not also fluorinated GHGs shall submit a one-time report that includes the concentration of each fluorinated HTF or fluorinated GHG constituent in each fluorinated HTF product as measured under § 98.414(n). If the facility commences production of a fluorinated HTF product that was not included in the initial report or performs a repeat measurement under § 98.414(n) that shows that the identities or concentrations of the fluorinated HTF or fluorinated GHG constituents of a fluorinated HTF product have changed, then the new or changed concentrations, as well as the date of the change, must be provided in a revised report. The revised report must be submitted to EPA by the March 31st that immediately follows the new or repeat measurement under § 98.414(n).
- (k) For nitrous oxide, saturated perfluorocarbons, sulfur hexafluoride, and fluorinated heat transfer fluids as defined at § 98.6, report the end use(s) for which each GHG or fluorinated HTF is transferred and the aggregated annual quantity of that GHG or fluorinated HTF in metric tons that is transferred to that end use application, if known.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79168, Dec. 17, 2010; 76 FR 73905, Nov. 29, 2011; 81 FR 89272, Dec. 9, 2016; 89 FR 31942, Apr. 25, 2024]

## § 98.417 Records that must be retained.

- (a) In addition to the data required by § 98.3(g), the fluorinated GHG or fluorinated HTF production facility shall retain the following records:
  - (1) Dated records of the data used to estimate the data reported under § 98.416.

- (2) Records documenting the initial and periodic calibration of the analytical equipment (including but not limited to GC, IR, FTIR, or NMR), weigh scales, flowmeters, and volumetric and density measures used to measure the quantities reported under this subpart, including the manufacturer directions or industry standards used for calibration pursuant to § 98.414(m) and (o).
- (3) Dated records of the total mass in metric tons of each reactant fed into the fluorinated GHG, fluorinated HTF, or nitrous oxide production process, by process.
- (4) Dated records of the total mass in metric tons of the reactants, by-products, and other wastes permanently removed from the fluorinated GHG, fluorinated HTF, or nitrous oxide production process, by process.
- (b) In addition to the data required by paragraph (a) of this section, any facility that destroys fluorinated GHGs or fluorinated HTFs shall keep records of test reports and other information documenting the facility's one-time destruction efficiency report in § 98.416(b).
- (c) In addition to the data required by § 98.3(g), the bulk importer shall retain the following records substantiating each of the imports that they report:
  - (1) A copy of the bill of lading for the import.
  - (2) The invoice for the import.
  - (3) The U.S. Customs entry form.
- (d) In addition to the data required by § 98.3(g), the bulk exporter shall retain the following records substantiating each of the exports that they report:
  - (1) A copy of the bill of lading for the export and
  - (2) The invoice for the export.
- (e) Every person who imports a container with a heel that is not reported under § 98.416(c) shall keep records of the amount brought into the United States that document that the residual amount in each shipment is less than 10 percent of the volume of the container and will:
  - (1) Remain in the container and be included in a future shipment.
  - (2) Be recovered and transformed.
  - (3) Be recovered and destroyed.
  - (4) Be recovered and included in a future shipment.
- (f) Isolated intermediates that are produced and transformed at the same facility are exempt from the recordkeeping requirements of this section.
- (g) Low-concentration constituents are exempt from the recordkeeping requirements of this section.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79168, Dec. 17, 2010; 76 FR 73905, Nov. 29, 2011; 81 FR 89273, Dec. 9, 2016]

## § 98.418 Definitions.

Except as provided below, all of the terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part. If a conflict exists between a definition provided in this subpart and a definition provided in subpart A, the definition in this subpart shall take precedence for the reporting requirements in this subpart.

*Isolated intermediate* means a product of a process that is stored before subsequent processing. An isolated intermediate is usually a product of chemical synthesis. Storage of an isolated intermediate marks the end of a process. Storage occurs at any time the intermediate is placed in equipment used solely for storage.

*Low-concentration constituent* means, for purposes of fluorinated GHG or fluorinated HTF production and export, a fluorinated GHG or fluorinated HTF constituent of a fluorinated GHG or fluorinated HTF product that occurs in the product in concentrations below 0.1 percent by mass. For purposes of fluorinated GHG or fluorinated HTF import, low-concentration constituent means a fluorinated GHG or fluorinated HTF constituent of a fluorinated GHG or fluorinated HTF product that occurs in the product in concentrations below 0.5 percent by mass. Low-concentration constituents do not include fluorinated GHGs or fluorinated HTFs that are deliberately combined with the product (e.g., to affect the performance characteristics of the product).

[75 FR 79169, Dec. 17, 2010, as amended at 81 FR 89273, Dec. 9, 2016]

## Subpart PP—Suppliers of Carbon Dioxide

### § 98.420 Definition of the source category.

- (a) The carbon dioxide (CO<sub>2</sub>) supplier source category consists of the following:
  - (1) Facilities with production process units that capture a CO<sub>2</sub> stream for purposes of supplying CO<sub>2</sub> for commercial applications or that capture and maintain custody of a CO<sub>2</sub> stream in order to sequester or otherwise inject it underground. Capture refers to the initial separation and removal of CO<sub>2</sub> from a manufacturing process or any other process.
  - (2) Facilities with CO<sub>2</sub> production wells that extract or produce a CO<sub>2</sub> stream for purposes of supplying CO<sub>2</sub> for commercial applications or that extract and maintain custody of a CO<sub>2</sub> stream in order to sequester or otherwise inject it underground.
  - (3) Importers or exporters of bulk CO<sub>2</sub>.
  - (4) Facilities with process units, including but not limited to direct air capture (DAC), that capture a CO<sub>2</sub> stream from ambient air for purposes of supplying CO<sub>2</sub> for commercial applications or that capture and maintain custody of a CO<sub>2</sub> stream in order to sequester or otherwise inject it underground.
- (b) This source category is focused on upstream supply. It does not cover:
  - (1) Storage of CO<sub>2</sub> above ground or in geologic formations.
  - (2) Use of CO<sub>2</sub> in enhanced oil and gas recovery.
  - (3) Transportation or distribution of CO<sub>2</sub>.
  - (4) Purification, compression, or processing of CO<sub>2</sub>.
  - (5) On-site use of CO<sub>2</sub> captured on site.
- (c) This source category does not include CO<sub>2</sub> imported or exported in equipment, such as fire extinguishers.

[74 FR 56374, Oct. 30, 2009, as amended at 89 FR 31943, Apr. 25, 2024]

## § 98.421 Reporting threshold.

Any supplier of CO<sub>2</sub> who meets the requirements of § 98.2(a)(4) of subpart A of this part must report the mass of CO<sub>2</sub> captured, extracted, imported, or exported.

## § 98.422 GHGs to report.

- (a) Mass of CO<sub>2</sub> captured from production process units.
- (b) Mass of CO<sub>2</sub> extracted from CO<sub>2</sub> production wells.
- (c) Mass of CO<sub>2</sub> imported.
- (d) Mass of CO<sub>2</sub> exported.
- (e) Mass of CO<sub>2</sub> captured from DAC process units.
  - (1) Mass of CO<sub>2</sub> captured from ambient air.
  - (2) Mass of CO<sub>2</sub> captured from any on-site heat and/or electricity generation, where applicable.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79169, Dec. 17, 2010; 89 FR 31943, Apr. 25, 2024]

## § 98.423 Calculating CO<sub>2</sub> supply.

- (a) Except as allowed in paragraph (b) of this section, calculate the annual mass of CO<sub>2</sub> captured, extracted, imported, or exported through each flow meter in accordance with the procedures specified in either paragraph (a)(1) or (a)(2) of this section. If multiple flow meters are used, you shall calculate the annual mass of CO<sub>2</sub> for all flow meters according to the procedures specified in paragraph (a)(3) of this section.
  - (1) For each mass flow meter, you shall calculate quarterly the mass of CO<sub>2</sub> in a CO<sub>2</sub> stream in metric tons by multiplying the mass flow by the composition data, according to Equation PP-1 of this section. Mass flow and composition data measurements shall be made in accordance with § 98.424 of this subpart.

$$CO_{2,u} = \sum_{p=1}^4 Q_{p,u} * C_{CO_2,p,u} \quad (\text{Eq. PP-1})$$

Where:

CO<sub>2,u</sub> = Annual mass of CO<sub>2</sub> (metric tons) through flow meter u.

C<sub>CO<sub>2</sub>,p,u</sub> = Quarterly CO<sub>2</sub> concentration measurement in flow for flow meter u in quarter p (wt. %CO<sub>2</sub>).

Q<sub>p,u</sub> = Quarterly mass flow rate measurement for flow meter u in quarter p (metric tons).

p = Quarter of the year.

u = Flow meter.

- (2) For each volumetric flow meter, you shall calculate quarterly the mass of CO<sub>2</sub> in a CO<sub>2</sub> stream in metric tons by multiplying the volumetric flow by the concentration and density data, according to Equation PP-2 of this section. Volumetric flow, concentration and density data measurements shall be made in accordance with § 98.424 of this section.

$$CO_{2,u} = \sum_{p=1}^4 Q_p \cdot D_p \cdot C_{CO_2,p} \quad (\text{Eq. PP-2})$$

Where:

CO<sub>2,u</sub> = Annual mass of CO<sub>2</sub> (metric tons) through flow meter u.

C<sub>CO<sub>2</sub>,p</sub> = Quarterly CO<sub>2</sub> concentration measurement in flow for flow meter u in quarter p (measured as either volume % CO<sub>2</sub> or weight % CO<sub>2</sub>).

Q<sub>p</sub> = Quarterly volumetric flow rate measurement for flow meter u in quarter p (standard cubic meters).

D<sub>p</sub> = Density of CO<sub>2</sub> in quarter p (metric tons CO<sub>2</sub> per standard cubic meter) for flow meter u if C<sub>CO<sub>2</sub>,p</sub> is measured as volume % CO<sub>2</sub>, or density of the whole CO<sub>2</sub> stream for flow meter u (metric tons per standard cubic meter) if C<sub>CO<sub>2</sub>,p</sub> is measured as weight % CO<sub>2</sub>.

p = Quarter of the year.

u = Flow meter.

- (3) To aggregate data, use either Equation PP-3a or PP-3b in this paragraph, as appropriate.

- (i) For facilities with production process units, DAC process units, or production wells that capture or extract a CO<sub>2</sub> stream and either measure it after segregation or do not segregate the flow, calculate the total CO<sub>2</sub> supplied in accordance with equation PP-3a to paragraph (a)(3)(i) of this section.

$$CO_2 = \sum_{p=1}^U CO_{2,u} \quad (\text{Eq. PP-3a})$$

where:

CO<sub>2</sub> = Total annual mass of CO<sub>2</sub> (metric tons).

CO<sub>2,u</sub> = Annual mass of CO<sub>2</sub> (metric tons) through flow meter u.

u = Flow meter.

- (ii) For facilities with production process units or DAC process units that capture a CO<sub>2</sub> stream and measure it ahead of segregation, calculate the total CO<sub>2</sub> supplied in accordance with equation PP-3b to paragraph (a)(3)(ii) of this section.

$$\text{CO}_2 = \sum_{p=1}^U \text{CO}_{2,u} - \sum_{p=1}^V \text{CO}_{2,v} \quad (\text{Eq. PP-3b})$$

where:

$\text{CO}_2$  = Total annual mass of  $\text{CO}_2$  (metric tons).

$\text{CO}_{2,u}$  = Annual mass of  $\text{CO}_2$  (metric tons) through main flow meter u.

$\text{CO}_{2,v}$  = Annual mass of  $\text{CO}_2$  (metric tons) through subsequent flow meter v for use on site.

u = Main flow meter.

v = Subsequent flow meter.

(b) As an alternative to paragraphs (a)(1) through (3) of this section for  $\text{CO}_2$  that is supplied in containers, calculate the annual mass of  $\text{CO}_2$  supplied in containers delivered by each  $\text{CO}_2$  stream in accordance with the procedures specified in either paragraph (b)(1) or (b)(2) of this section. If multiple  $\text{CO}_2$  streams are used to deliver  $\text{CO}_2$  to containers, you shall calculate the annual mass of  $\text{CO}_2$  supplied in containers delivered by all  $\text{CO}_2$  streams according to the procedures specified in paragraph (b)(3) of this section.

(1) For each  $\text{CO}_2$  stream that delivers  $\text{CO}_2$  to containers, for which mass is measured, you shall calculate  $\text{CO}_2$  supply in containers using Equation PP-1 of this section.

where:

$\text{CO}_{2,u}$  = Annual mass of  $\text{CO}_2$  (metric tons) supplied in containers delivered by  $\text{CO}_2$  stream u.

$C_{\text{CO}_2,p,u}$  = Quarterly  $\text{CO}_2$  concentration measurement of  $\text{CO}_2$  stream u that delivers  $\text{CO}_2$  to containers in quarter p (wt. % $\text{CO}_2$ ).

$Q_{p,u}$  = Quarterly mass of contents supplied in all containers delivered by  $\text{CO}_2$  stream u in quarter p (metric tons).

p = Quarter of the year.

u =  $\text{CO}_2$  stream that delivers to containers.

(2) For each  $\text{CO}_2$  stream that delivers to containers, for which volume is measured, you shall calculate  $\text{CO}_2$  supply in containers using Equation PP-2 of this section.

where:

$\text{CO}_{2,u}$  = Annual mass of  $\text{CO}_2$  (metric tons) supplied in containers delivered by  $\text{CO}_2$  stream u.

$C_{\text{CO}_2,p}$  = Quarterly  $\text{CO}_2$  concentration measurement of  $\text{CO}_2$  stream u that delivers  $\text{CO}_2$  to containers in quarter p (measured as either volume %  $\text{CO}_2$  or weight %  $\text{CO}_2$ ).

$Q_p$  = Quarterly volume of contents supplied in all containers delivered by CO<sub>2</sub> stream  $u$  in quarter  $p$  (standard cubic meters).

$D_p$  = Quarterly CO<sub>2</sub> density determination for CO<sub>2</sub> stream  $u$  in quarter  $p$  (metric tons per standard cubic meter) if CO<sub>2,p</sub> is measured as volume % CO<sub>2</sub>, or density of CO<sub>2</sub> stream  $u$  (metric tons per standard cubic meter) if CO<sub>2,p</sub> is measured as weight % CO<sub>2</sub>.

$p$  = Quarter of the year.

$u$  = CO<sub>2</sub> stream that delivers to containers.

- (3) To aggregate data, sum the mass of CO<sub>2</sub> supplied in containers delivered by all CO<sub>2</sub> streams in accordance with Equation PP-3a of this section.

where:

CO<sub>2</sub> = Annual mass of CO<sub>2</sub> (metric tons) supplied in containers delivered by all CO<sub>2</sub> streams.

CO<sub>2,u</sub> = Annual mass of CO<sub>2</sub> (metric tons) supplied in containers delivered by CO<sub>2</sub> stream  $u$ .

$u$  = CO<sub>2</sub> stream that delivers to containers.

- (c) Importers or exporters that import or export CO<sub>2</sub> in containers shall calculate the total mass of CO<sub>2</sub> imported or exported in metric tons based on summing the mass in each CO<sub>2</sub> container using weigh bills, scales, or load cells according to Equation PP-4 of this section.

$$CO_2 = \sum_{p=1}^I Q \quad (\text{Eq. PP-4})$$

where:

CO<sub>2</sub> = Annual mass of CO<sub>2</sub> (metric tons).

$Q$  = Annual mass in all CO<sub>2</sub> containers imported or exported during the reporting year (metric tons).

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79169, Dec. 17, 2010; 78 FR 71977, Nov. 29, 2013; 89 FR 31943, Apr. 25, 2024]

## § 98.424 Monitoring and QA/QC requirements.

### (a) Determination of quantity.

- (1) Reporters following the procedures in § 98.423(a) shall determine quantity using a flow meter or meters located in accordance with this paragraph.

- (i) If the CO<sub>2</sub> stream is segregated such that only a portion is captured for commercial application or for injection, you must locate the flow meter according to the following:

- (A) For reporters following the procedures in § 98.423(a)(3)(i), you must locate the flow meter(s) after the point of segregation.

- (B) For reporters following the procedures in paragraph (a)(3)(ii) of § 98.423, you must locate the main flow meter(s) on the captured CO<sub>2</sub> stream(s) prior to the point of segregation and the subsequent flow meter(s) on the CO<sub>2</sub> stream(s) for on-site use after the point of segregation. You may only follow the procedures in paragraph (a)(3)(ii) of § 98.423 if the CO<sub>2</sub> stream(s) for on-site use is/are the only diversion(s) from the main, captured CO<sub>2</sub> stream(s) after the main flow meter location(s).
  - (ii) Reporters that have a mass flow meter or volumetric flow meter installed to measure the flow of a CO<sub>2</sub> stream that meets the requirements of paragraph (a)(1)(i) of this section shall base calculations in § 98.423 of this subpart on the installed mass flow or volumetric flow meters.
  - (iii) Reporters that do not have a mass flow meter or volumetric flow meter installed to measure the flow of the CO<sub>2</sub> stream that meets the requirements of paragraph (a)(1)(i) of this section shall base calculations in § 98.423 of this subpart on the flow of gas transferred off site using a mass flow meter or a volumetric flow meter located at the point of off-site transfer.
- (2) Reporters following the procedures in paragraph (b) of § 98.423 shall determine quantity in accordance with this paragraph.
- (i) Reporters that supply CO<sub>2</sub> in containers using weigh bills, scales, or load cells shall measure the mass of contents of each CO<sub>2</sub> container to which the CO<sub>2</sub> stream is delivered, sum the mass of contents supplied in all containers to which the CO<sub>2</sub> stream is delivered during each quarter, sample the CO<sub>2</sub> stream delivering CO<sub>2</sub> to containers on a quarterly basis to determine the composition of the CO<sub>2</sub> stream, and apply Equation PP-1.
  - (ii) Reporters that supply CO<sub>2</sub> in containers using loaded container volumes shall measure the volume of contents of each CO<sub>2</sub> container to which the CO<sub>2</sub> stream is delivered, sum the volume of contents supplied in all containers to which the CO<sub>2</sub> stream is delivered during each quarter, sample the CO<sub>2</sub> stream on a quarterly basis to determine the composition of the CO<sub>2</sub> stream, determine the density quarterly, and apply Equation PP-2.
- (3) Importers or exporters that import or export CO<sub>2</sub> in containers shall measure the mass in each CO<sub>2</sub> container using weigh bills, scales, or load cells and sum the mass in all containers imported or exported during the reporting year.
- (4) All flow meters, scales, and load cells used to measure quantities that are reported in § 98.423 of this subpart shall be operated and calibrated according to the following procedure:
- (i) You shall use an appropriate standard method published by a consensus-based standards organization if such a method exists. Consensus-based standards organizations include, but are not limited to, the following: ASTM International, the American National Standards Institute (ANSI), the American Gas Association (AGA), the American Society of Mechanical Engineers (ASME), the American Petroleum Institute (API), and the North American Energy Standards Board (NAESB).
  - (ii) Where no appropriate standard method developed by a consensus-based standards organization exists, you shall follow industry standard practices.
  - (iii) You must ensure that any flow meter calibrations performed are NIST traceable.
- (5) Reporters using Equation PP-2 of this subpart and measuring CO<sub>2</sub> concentration as weight % CO<sub>2</sub> shall determine the density of the CO<sub>2</sub> stream on a quarterly basis in order to calculate the mass of the CO<sub>2</sub> stream according to one of the following procedures:



(i) You may use a method published by a consensus-based standards organization. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Gas Association (AGA, 400 North Capitol Street, NW., 4th Floor, Washington, DC 20001, (202) 824-7000, <http://www.aga.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), the American Petroleum Institute (API, 1220 L Street, NW., Washington, DC 20005-4070, (202) 682-8000, <http://www.api.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>). The method(s) used shall be documented in the Monitoring Plan required under § 98.3(g)(5).

(ii) You may follow an industry standard method.

**(b) Determination of concentration.**

- (1) Reporters using Equation PP-1 or PP-2 of this subpart shall sample the CO<sub>2</sub> stream on a quarterly basis to determine the composition of the CO<sub>2</sub> stream.
- (2) Methods to measure the composition of the CO<sub>2</sub> stream must conform to applicable chemical analytical standards. Acceptable methods include, but are not limited to, the U.S. Food and Drug Administration food-grade specifications for CO<sub>2</sub> (see 21 CFR 184.1240) and ASTM standard E1747-95 (Reapproved 2005) Standard Guide for Purity of Carbon Dioxide Used in Supercritical Fluid Applications (ASTM International, 100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>).

(c) You shall convert the density of the CO<sub>2</sub> stream(s) and all measured volumes of carbon dioxide to the following standard industry temperature and pressure conditions: Standard cubic meters at a temperature of 60 degrees Fahrenheit and at an absolute pressure of 1 atmosphere. If you apply the density value for CO<sub>2</sub> at standard conditions, you must use 0.001868 metric tons per standard cubic meter.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79170, Dec. 17, 2010]

**§ 98.425 Procedures for estimating missing data.**

- (a) Whenever the quality assurance procedures in § 98.424(a)(1) of this subpart cannot be followed to measure quarterly mass flow or volumetric flow of CO<sub>2</sub>, the most appropriate of the following missing data procedures shall be followed:
- (1) A quarterly CO<sub>2</sub> mass flow or volumetric flow value that is missing may be substituted with a quarterly value measured during another quarter of the current reporting year.
  - (2) A quarterly CO<sub>2</sub> mass flow or volumetric flow value that is missing may be substituted with a quarterly value measured during the same quarter from the past reporting year.
  - (3) If a mass or volumetric flow meter is installed to measure the CO<sub>2</sub> stream, you may substitute data from a mass or volumetric flow meter measuring the CO<sub>2</sub> stream transferred for any period during which the installed meter is inoperable.

- (4) The mass or volumetric flow used for purposes of product tracking and billing according to the reporter's established procedures may be substituted for any period during which measurement equipment is inoperable.
- (b) Whenever the quality assurance procedures in § 98.424(b) cannot be followed to determine concentration of the CO<sub>2</sub> stream, the most appropriate of the following missing data procedures shall be followed:
  - (1) A quarterly concentration value that is missing may be substituted with a quarterly value measured during another quarter of the current reporting year.
  - (2) A quarterly concentration value that is missing may be substituted with a quarterly value measured during the same quarter from the previous reporting year.
  - (3) The concentration used for purposes of product tracking and billing according to the reporter's established procedures may be substituted for any quarterly value.
- (c) Missing data on density of the CO<sub>2</sub> stream shall be substituted with quarterly or annual average values from the previous calendar year.
- (d) Whenever the quality assurance procedures in § 98.424(a)(2) of this subpart cannot be followed to measure quarterly quantity of CO<sub>2</sub> in containers, the most appropriate of the following missing data procedures shall be followed:
  - (1) A quarterly quantity of CO<sub>2</sub> in containers that is missing may be substituted with a quarterly value measured during another representative quarter of the current reporting year.
  - (2) A quarterly quantity of CO<sub>2</sub> in containers that is missing may be substituted with a quarterly value measured during the same quarter from the past reporting year.
  - (3) The quarterly quantity of CO<sub>2</sub> in containers recorded for purposes of product tracking and billing according to the reporter's established procedures may be substituted for any period during which measurement equipment is inoperable.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79171, Dec. 17, 2010; 81 FR 89273, Dec. 9, 2016]

## § 98.426 Data reporting requirements.

In addition to the information required by § 98.3(c) of subpart A of this part, the annual report shall contain the following information, as applicable:

- (a) If you use Equation PP-1 of this subpart, report the following information for each mass flow meter or CO<sub>2</sub> stream that delivers CO<sub>2</sub> to containers:
  - (1) Annual mass in metric tons of CO<sub>2</sub>.
  - (2) Quarterly mass in metric tons of CO<sub>2</sub>.
  - (3) Quarterly concentration of the CO<sub>2</sub> stream.
  - (4) The standard used to measure CO<sub>2</sub> concentration.
  - (5) The location of the flow meter in your process chain in relation to the points of CO<sub>2</sub> stream capture, dehydration, compression, and other processing.

- (b) If you use Equation PP-2 of this subpart, report the following information for each volumetric flow meter or CO<sub>2</sub> stream that delivers CO<sub>2</sub> to containers:
  - (1) Annual mass in metric tons of CO<sub>2</sub>.
  - (2) Quarterly volume in standard cubic meters of CO<sub>2</sub>.
  - (3) Quarterly concentration of the CO<sub>2</sub> stream in volume or weight percent.
  - (4) Report density as follows:
    - (i) Quarterly density of the CO<sub>2</sub> stream in metric tons per standard cubic meter if you report the concentration of the CO<sub>2</sub> stream in paragraph (b)(3) of this section in weight percent.
    - (ii) Quarterly density of CO<sub>2</sub> in metric tons per standard cubic meter if you report the concentration of the CO<sub>2</sub> stream in paragraph (b)(3) of this section in volume percent.
  - (5) The method used to measure density.
  - (6) The standard used to measure CO<sub>2</sub> concentration.
  - (7) The location of the flow meter in your process chain in relation to the points of CO<sub>2</sub> stream capture, dehydration, compression, and other processing.
- (c) For the aggregated annual mass of CO<sub>2</sub> emissions calculated using Equation PP-3a or PP-3b, report the following:
  - (1) If you use Equation PP-3a of this subpart, report the annual CO<sub>2</sub> mass in metric tons from all flow meters and CO<sub>2</sub> streams that deliver CO<sub>2</sub> to containers.
  - (2) If you use Equation PP-3b of this subpart, report:
    - (i) The total annual CO<sub>2</sub> mass through main flow meter(s) in metric tons.
    - (ii) The total annual CO<sub>2</sub> mass through subsequent flow meter(s) in metric tons.
    - (iii) The total annual CO<sub>2</sub> mass supplied in metric tons.
    - (iv) The location of each flow meter in relation to the point of segregation.
- (d) If you use Equation PP-4 of this subpart, report at the corporate level the annual mass of CO<sub>2</sub> in metric tons in all CO<sub>2</sub> containers that are imported or exported.
- (e) Each reporter shall report the following information:
  - (1) The type of equipment used to measure the total flow of the CO<sub>2</sub> stream or the total mass or volume in CO<sub>2</sub> containers.
  - (2) The standard used to operate and calibrate the equipment reported in (e)(1) of this section.
  - (3) The number of days in the reporting year for which substitute data procedures were used for the following purpose:
    - (i) To measure quantity.
    - (ii) To measure concentration.
    - (iii) To measure density.

- (f) Report the aggregated annual quantity of CO<sub>2</sub> in metric tons that is transferred to each of the following end use applications, if known:
  - (1) Food and beverage.
  - (2) Industrial and municipal water/wastewater treatment.
  - (3) Metal fabrication, including welding and cutting.
  - (4) Greenhouse uses for plant growth.
  - (5) Fumigants (e.g., grain storage) and herbicides.
  - (6) Pulp and paper.
  - (7) Cleaning and solvent use.
  - (8) Fire fighting.
  - (9) Transportation and storage of explosives.
  - (10) Injection of carbon dioxide for enhanced oil and natural gas recovery that is covered by subpart UU of this part.
  - (11) Geologic sequestration of carbon dioxide that is covered by subpart RR of this part.
  - (12) Geologic sequestration of carbon dioxide with enhanced oil recovery that is covered by subpart VV of this part.
  - (13) Research and development.
  - (14) Other.
- (g) Each production process unit that captures a CO<sub>2</sub> stream for purposes of supplying CO<sub>2</sub> for commercial applications or in order to sequester or otherwise inject it underground when custody of the CO<sub>2</sub> is maintained shall report the percentage of that stream, if any, that is biomass-based during the reporting year.
- (h) If you capture a CO<sub>2</sub> stream from a facility that is subject to this part and transfer CO<sub>2</sub> to any facilities that are subject to subpart RR or VV of this part, you must:
  - (1) Report the facility identification number associated with the annual GHG report for the facility that is the source of the captured CO<sub>2</sub> stream;
  - (2) Report each facility identification number associated with the annual GHG reports for each subpart RR and subpart VV facility to which CO<sub>2</sub> is transferred; and
  - (3) Report the annual quantity of CO<sub>2</sub> in metric tons that is transferred to each subpart RR and subpart VV facility.
- (i) If you capture a CO<sub>2</sub> stream at a facility with a DAC process unit, report the annual quantity of on-site and off-site electricity and heat generated for each DAC process unit as specified in paragraphs (i)(1) through (3) of this section. The quantities specified in paragraphs (i)(1) through (3) of this section must be provided per energy source if known and must represent the electricity and heat used for the DAC process unit starting with air intake and ending with the compressed CO<sub>2</sub> stream (i.e., the CO<sub>2</sub> stream ready for supply for commercial applications or, if maintaining custody of the stream, sequestration or injection of the stream underground).

- (1) **Electricity excluding combined heat and power (CHP).** If electricity is provided to a dedicated meter for the DAC process unit, report the annual quantity of electricity consumed, in megawatt hours (MWh), and the information in paragraph (i)(1)(i) or (ii) of this section.
  - (i) If the electricity is sourced from a grid connection, report the following information:
    - (A) State where the facility with the DAC process unit is located.
    - (B) County where the facility with the DAC process unit is located.
    - (C) Name of the electric utility company that supplied the electricity as shown on the last monthly bill issued by the utility company during the reporting period.
    - (D) Name of the electric utility company that delivered the electricity. In states with regulated electric utility markets, this will generally be the same utility reported under paragraph (i)(1)(i)(C) of this section, but in states with deregulated electric utility markets, this may be a different utility company.
    - (E) Annual quantity of electricity consumed in MWh, calculated as the sum of the total energy usage values specified in all billing statements received during the reporting year. Most customers will receive 12 monthly billing statements during the reporting year. Many utilities bill their customers per kilowatt-hour (kWh); usage values on bills that are based on kWh should be divided by 1,000 to report the usage in MWh as required under this paragraph (i)(1)(i)(E).
  - (ii) If electricity is sourced from on-site or through a contractual mechanism for dedicated off-site generation, for each applicable energy source specified in paragraphs (i)(1)(ii)(A) through (G) of this section, report the annual quantity of electricity consumed, in MWh. If the on-site electricity source is natural gas, oil, or coal, also indicate whether flue gas is also captured by the DAC process unit.
    - (A) Non-hydropower renewable sources including solar, wind, geothermal and tidal.
    - (B) Hydropower.
    - (C) Natural gas.
    - (D) Oil.
    - (E) Coal.
    - (F) Nuclear.
    - (G) Other.
- (2) **Heat excluding CHP.** For each applicable energy source specified in paragraphs (i)(2)(i) through (vii) of this section, report the annual quantity of heat, steam, or other forms of thermal energy sourced from on-site or through a contractual mechanism for dedicated off-site generation, in megajoules (MJ). If the on-site heat source is natural gas, oil, or coal, also indicate whether flue gas is also captured by the DAC process unit.
  - (i) Solar.
  - (ii) Geothermal.
  - (iii) Natural gas.

- (iv) Oil.
- (v) Coal.
- (vi) Nuclear.
- (vii) Other.

(3) **CHP—**

(i) **Electricity from CHP.** If electricity from CHP is sourced from on-site or through a contractual mechanism for dedicated off-site generation, for each applicable energy source specified in paragraphs (i)(3)(i)(A) through (G) of this section, report the annual quantity consumed, in MWh. If the on-site electricity source for CHP is natural gas, oil, or coal, also indicate whether flue gas is also captured by the DAC process unit.

- (A) Non-hydropower renewable sources including solar, wind, geothermal and tidal.
- (B) Hydropower.
- (C) Natural gas.
- (D) Oil.
- (E) Coal.
- (F) Nuclear.
- (G) Other.

(ii) **Heat from CHP.** For each applicable energy source specified in paragraphs (i)(3)(ii)(A) through (G) of this section, report the quantity of heat, steam, or other forms of thermal energy from CHP sourced from on-site or through a contractual mechanism for dedicated off-site generation, in MJ. If the on-site heat source is natural gas, oil, or coal, also indicate whether flue gas is also captured by the DAC process unit.

- (A) Solar.
- (B) Geothermal.
- (C) Natural gas.
- (D) Oil.
- (E) Coal.
- (F) Nuclear.
- (G) Other.

[74 FR 56374, Oct. 30, 2009, as amended at 75 FR 79171, Dec. 17, 2010; 78 FR 71977, Nov. 29, 2013; 80 FR 64660, Oct. 23, 2015; 89 FR 31943, Apr. 25, 2024]

## § 98.427 Records that must be retained.

In addition to the records required by § 98.3(g) of subpart A of this part, you must retain the records specified in paragraphs (a) through (c) of this section, as applicable.

- (a) The owner or operator of a facility containing production process units or DAC process units must retain quarterly records of captured or transferred CO<sub>2</sub> streams and composition.
- (b) The owner or operator of a CO<sub>2</sub> production well facility must maintain quarterly records of the mass flow or volumetric flow of the extracted or transferred CO<sub>2</sub> stream and concentration and density if volumetric flow meters are used.
- (c) Importers or exporters of CO<sub>2</sub> must retain annual records of the mass flow, volumetric flow, and mass of CO<sub>2</sub> imported or exported.
- (d) Facilities subject to § 98.426(h) must retain records of CO<sub>2</sub> in metric tons that is transferred to each subpart RR facility.

[74 FR 56374, Oct. 30, 2009, as amended at 80 FR 64660, Oct. 23, 2015; 89 FR 31944, Apr. 25, 2024]

### § 98.428 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

### Subpart QQ—Importers and Exporters of Fluorinated Greenhouse Gases Contained in Pre-Charged Equipment or Closed-Cell Foams

Source: 75 FR 74856, Dec. 1, 2010, unless otherwise noted.

### § 98.430 Definition of the source category.

- (a) The source category, importers and exporters of fluorinated GHGs contained in pre-charged equipment or closed-cell foams, consists of any entity that imports or exports pre-charged equipment that contains a fluorinated GHG, and any entity that imports or exports closed-cell foams that contain a fluorinated GHG.

### § 98.431 Reporting threshold.

Any importer or exporter of fluorinated GHGs contained in pre-charged equipment or closed-cell foams who meets the requirements of § 98.2(a)(4) must report each fluorinated GHG contained in the imported or exported pre-charged equipment or closed-cell foams.

### § 98.432 GHGs to report.

You must report the mass of each fluorinated GHG contained in pre-charged equipment or closed-cell foams that you import or export during the calendar year. For imports and exports of closed-cell foams where you do not know the identity and mass of the fluorinated GHG, you must report the mass of fluorinated GHG in CO<sub>2</sub>e.

### § 98.433 Calculating GHG contained in pre-charged equipment or closed-cell foams.

- (a) The total mass of each fluorinated GHG imported and exported inside equipment or foams must be estimated using Equation QQ-1 of this section:

$$I = \sum_i S_i * N_i * 0.001 \quad (\text{Eq. QQ-1})$$

where:

$I$  = Total mass of the fluorinated GHG imported or exported annually (metric tons).

$t$  = Equipment/foam type containing the fluorinated GHG.

$S_t$  = Mass of fluorinated GHG per unit of equipment type  $t$  or foam type  $t$  (charge per piece of equipment, kg) or density of fluorinated GHG in foam (charge per cubic foot of foam, kg per cubic foot).

$N_t$  = Number of units of equipment type  $t$  or foam type  $t$  imported or exported annually (pieces of equipment or cubic feet of foam).

0.001 = Factor converting kg to metric tons.

- (b) When the identity and mass of fluorinated GHGs in a closed-cell foam is unknown to the importer or exporter, the total mass in CO<sub>2</sub>e for the fluorinated GHGs imported and exported inside closed-cell foams must be estimated using Equation QQ-2 of this section:

$$I = \sum_t S_t * N_t * 0.001 \text{ (Eq. QQ-2)}$$

where:

$I$  = Total mass in CO<sub>2</sub>e of the fluorinated GHGs imported or exported in close-cell foams annually (metric tons).

$t$  = Equipment/foam type containing the fluorinated GHG.

$S_t$  = Mass in CO<sub>2</sub>e of the fluorinated GHGs per unit of equipment type  $t$  or foam type  $t$  (charge per piece of equipment, kg) or density of fluorinated GHG in foam (CO<sub>2</sub>e per cubic foot of foam, kg CO<sub>2</sub>e per cubic foot).

$N_t$  = Number of units of equipment type  $t$  or foam type  $t$  imported or exported annually (pieces of equipment or cubic feet of foam).

0.001 = Factor converting kg to metric tons.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71978, Nov. 29, 2013]

## § 98.434 Monitoring and QA/QC requirements.

- (a) For calendar year 2011 monitoring, you may follow the provisions of § 98.3(d)(1) through (d)(2) for best available monitoring methods rather than follow the monitoring requirements of this section. For purposes of this subpart, any reference in § 98.3(d)(1) through (d)(2) to the year 2010 means 2011, to March 31 means June 30, and to April 1 means July 1. Any reference to the effective date or date of promulgation in § 98.3(d)(1) through (d)(2) means February 28, 2011.
- (b) The inputs to the annual submission must be reviewed against the import or export transaction records to ensure that the information submitted to EPA is being accurately transcribed as the correct chemical or blend in the correct pre-charged equipment or closed-cell foam in the correct quantities and units.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71978, Nov. 29, 2013]



## § 98.435 Procedures for estimating missing data.

Procedures for estimating missing data are not provided for importers and exporters of fluorinated GHGs contained in pre-charged equipment or closed-cell foams. A complete record of all measured parameters used in tracking fluorinated GHGs contained in pre-charged equipment or closed-cell foams is required.

## § 98.436 Data reporting requirements.

- (a) Each importer of fluorinated GHGs contained in pre-charged equipment or closed-cell foams must submit an annual report that summarizes its imports at the corporate level, except for transshipments, as specified:
  - (1) Total mass in metric tons of each fluorinated GHG imported in pre-charged equipment or closed-cell foams.
  - (2) For each type of pre-charged equipment with a unique combination of charge size and charge type, the identity of the fluorinated GHG used as a refrigerant or electrical insulator, charge size (holding charge, if applicable), and number imported.
  - (3) For closed-cell foams that are imported inside of equipment, the identity of the fluorinated GHG contained in the foam, the mass of the fluorinated GHG contained in the foam in each piece of equipment, and the number of pieces of equipment imported with each unique combination of mass and identity of fluorinated GHG within the closed-cell foams.
  - (4) For closed cell-foams that are not imported inside of equipment, the identity of the fluorinated GHG in the foam, the density of the fluorinated GHG in the foam (kg fluorinated GHG/cubic foot), and the volume of foam imported (cubic feet) for each type of closed-cell foam with a unique combination of fluorinated GHG density and identity.
  - (5) Dates on which the pre-charged equipment or closed-cell foams were imported.
  - (6) If the importer does not know the identity and mass of the fluorinated GHGs within the closed-cell foam, the importer must report the following:
    - (i) Total mass in metric tons of CO<sub>2</sub>e of the fluorinated GHGs imported in closed-cell foams.
    - (ii) For closed-cell foams that are imported inside of equipment, the mass of the fluorinated GHGs in CO<sub>2</sub>e contained in the foam in each piece of equipment and the number of pieces of equipment imported for each equipment type.
    - (iii) For closed-cell foams that are not imported inside of equipment, the density in CO<sub>2</sub>e of the fluorinated GHGs in the foam (kg CO<sub>2</sub>e/cubic foot) and the volume of foam imported (cubic feet) for each type of closed-cell foam.
    - (iv) Dates on which the closed-cell foams were imported.
    - (v) Name of the foam manufacturer for each type of closed-cell foam where the identity and mass of the fluorinated GHGs is unknown.
    - (vi) Certification that the importer was unable to obtain information on the identity and mass of the fluorinated GHGs within the closed-cell foam from the closed-cell foam manufacturer or manufacturers.

- (7) The Harmonized tariff system (HTS) code for each type of pre-charged equipment or closed-cell foam imported.
- (b) Each exporter of fluorinated GHGs contained in pre-charged equipment or closed-cell foams must submit an annual report that summarizes its exports at the corporate level, except for transshipments, as specified:
  - (1) Total mass in metric tons of each fluorinated GHG exported in pre-charged equipment or closed-cell foams.
  - (2) For each type of pre-charged equipment with a unique combination of charge size and charge type, the identity of the fluorinated GHG used as a refrigerant or electrical insulator, charge size (including holding charge, if applicable), and number exported.
  - (3) For closed-cell foams that are exported inside of equipment, the identity of the fluorinated GHG contained in the foam in each piece of equipment, the mass of the fluorinated GHG contained in the foam in each piece of equipment, and the number of pieces of equipment exported with each unique combination of mass and identity of fluorinated GHG within the closed-cell foams.
  - (4) For closed-cell foams that are not exported inside of equipment, the identity of the fluorinated GHG in the foam, the density of the fluorinated GHG in the foam (kg fluorinated GHG/cubic foot), and the volume of foam exported (cubic feet) for each type of closed-cell foam with a unique combination of fluorinated GHG density and identity.
  - (5) Dates on which the pre-charged equipment or closed-cell foams were exported.
  - (6) If the exporter does not know the identity and mass of the fluorinated GHG within the closed-cell foam, the exporter must report the following:
    - (i) Total mass in metric tons of CO<sub>2</sub>e of the fluorinated GHGs exported in closed-cell foams.
    - (ii) For closed-cell foams that are exported inside of equipment, the mass of the fluorinated GHGs in CO<sub>2</sub>e contained in the foam in each piece of equipment and the number of pieces of equipment imported for each equipment type.
    - (iii) For closed-cell foams that are not exported inside of equipment, the density in CO<sub>2</sub>e of the fluorinated GHGs in the foam (kg CO<sub>2</sub> e/cubic foot) and the volume of foam imported (cubic feet) for each type of closed-cell foam.
    - (iv) Dates on which the closed-cell foams were exported.
    - (v) Name of the foam manufacturer for each type of closed-cell foam where the identity and mass of the fluorinated GHG is unknown.
    - (vi) Certification that the exporter was unable to obtain information on the identity and mass of the fluorinated GHGs within the closed-cell foam from the closed-cell foam manufacturer or manufacturers.
- (7) The Schedule B code for each type of pre-charged equipment or closed-cell foam exported.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71978, Nov. 29, 2013; 89 FR 31944, Apr. 25, 2024]

## § 98.437 Records that must be retained.

- (a) In addition to the data required by § 98.3(g), importers of fluorinated GHGs in pre-charged equipment and closed-cell foams must retain the following records substantiating each of the imports that they report:
  - (1) A copy of the bill of lading for the import.
  - (2) The invoice for the import.
  - (3) The U.S. Customs entry form.
  - (4) Ports of entry through which the pre-charged equipment or closed-cell foams passed.
  - (5) Countries from which the pre-charged equipment or closed-cell foams were imported.
  - (6) For importers that report the mass of fluorinated GHGs within closed-cell foams on a CO<sub>2</sub>e basis, correspondence or other documents that show the importer was unable to obtain information on the identity and mass of fluorinated GHG within closed-cell foams from the foam manufacturer.
- (b) In addition to the data required by § 98.3(g), exporters of fluorinated GHGs in pre-charged equipment and closed-cell foams must retain the following records substantiating each of the exports that they report:
  - (1) A copy of the bill of lading for the export and
  - (2) The invoice for the export.
  - (3) Ports of exit through which the pre-charged equipment or closed-cell foams passed.
  - (4) Countries to which the pre-charged equipment or closed-cell foams were exported.
  - (5) For exporters that report the mass of fluorinated GHGs within closed-cell foams on a CO<sub>2</sub>e basis, correspondence or other documents that show the exporter was unable to obtain information on the identity and mass of fluorinated GHG within closed-cell foams from the foam manufacturer.
- (c) For importers and exports of fluorinated GHGs inside pre-charged equipment and closed-cell foams, the GHG Monitoring Plans, as described in § 98.3(g)(5), must be completed by April 1, 2011.
- (d) Persons who transship pre-charged equipment and closed-cell foams containing fluorinated GHGs must maintain records that indicated that the pre-charged equipment or foam originated in a foreign country and was destined for another foreign country and did not enter into commerce in the United States.

## § 98.438 Definitions.

Except as provided in this section, all of the terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part. If a conflict exists between a definition provided in this subpart and a definition provided in subpart A, the definition in this subpart must take precedence for the reporting requirements in this subpart.

**Appliance** means any device which contains and uses a fluorinated greenhouse gas refrigerant and which is used for household or commercial purposes, including any air conditioner, refrigerator, chiller, or freezer.

**Closed-cell foam** means any foam product, excluding packaging foam, that is constructed with a closed-cell structure and a blowing agent containing a fluorinated GHG. Closed-cell foams include but are not limited to polyurethane (PU) foam contained in equipment, PU continuous and discontinuous panel foam, PU one component foam, PU spray foam, extruded polystyrene (XPS) boardstock foam, and XPS sheet foam. Packaging foam means foam used exclusively during shipment or storage to temporarily enclose items.

*Electrical equipment* means gas-insulated substations, circuit breakers, other switchgear, gas-insulated lines, or power transformers.

*Fluorinated GHG refrigerant* means, for purposes of this subpart, any substance consisting in part or whole of a fluorinated greenhouse gas and that is used for heat transfer purposes and provides a cooling effect.

*Pre-charged appliance* means any appliance charged with fluorinated greenhouse gas refrigerant prior to sale or distribution or offer for sale or distribution in interstate commerce. This includes both appliances that contain the full charge necessary for operation and appliances that contain a partial “holding” charge of the fluorinated greenhouse gas refrigerant (e.g., for shipment purposes).

*Pre-charged appliance component* means any portion of an appliance, including but not limited to condensers, compressors, line sets, and coils, that is charged with fluorinated greenhouse gas refrigerant prior to sale or distribution or offer for sale or distribution in interstate commerce.

*Pre-charged electrical equipment* means any electrical equipment, including but not limited to gas-insulated substations, circuit breakers, other switchgear, gas-insulated lines, or power transformers containing a fluorinated GHG prior to sale or distribution, or offer for sale or distribution in interstate commerce. This includes both equipment that contain the full charge necessary for operation and equipment that contain a partial “holding” charge of the fluorinated GHG (e.g., for shipment purposes).

*Pre-charged electrical equipment component* means any portion of electrical equipment that is charged with a fluorinated greenhouse gas prior to sale or distribution or offer for sale or distribution in interstate commerce.

*Pre-charged equipment* means any pre-charged appliance, pre-charged appliance component, pre-charged electrical equipment, or pre-charged electrical equipment component.

[74 FR 56374, Oct. 30, 2009, as amended at 78 FR 71978, Nov. 29, 2013]

## Subpart RR—Geologic Sequestration of Carbon Dioxide

**Source:** 75 FR 75078, Dec. 1, 2010, unless otherwise noted.

### § 98.440 Definition of the source category.

- (a) The geologic sequestration of carbon dioxide (CO<sub>2</sub>) source category comprises any well or group of wells that inject a CO<sub>2</sub> stream for long-term containment in subsurface geologic formations.
- (b) This source category includes all wells permitted as Class VI under the Underground Injection Control program.
- (c) This source category does not include a well or group of wells where a CO<sub>2</sub> stream is being injected in subsurface geologic formations to enhance the recovery of oil or natural gas unless one of the following applies:
  - (1) The owner or operator injects the CO<sub>2</sub> stream for long-term containment in subsurface geologic formations and has chosen to submit a proposed monitoring, reporting, and verification (MRV) plan to EPA and received an approved plan from EPA.
  - (2) The well is permitted as Class VI under the Underground Injection Control program.

- (d) **Exemption for research and development projects.** Research and development projects shall receive an exemption from reporting under this subpart for the duration of the research and development activity.
  - (1) **Process for obtaining an exemption.** If you are a research and development project, you must submit the information in paragraph (d)(2) of this section to EPA by the time you would be otherwise required to submit an MRV plan under § 98.448. EPA will use this information to verify that the project is a research and development project.
  - (2) **Content of submission.** A submission in support of an exemption as a research and development project must contain the following information:
    - (i) The planned duration of CO<sub>2</sub> injection for the project.
    - (ii) The planned annual CO<sub>2</sub> injection volumes during this time period.
    - (iii) The research purposes of the project.
    - (iv) The source and type of funding for the project.
    - (v) The class and duration of Underground Injection Control permit or, for an offshore facility not subject to the Safe Drinking Water Act, a description of the legal instrument authorizing geologic sequestration.
  - (3) **Determination by the Administrator.**
    - (i) The Administrator shall determine if a project meets the definition of research and development project within 60 days of receipt of the submission of a request for exemption. In making this determination, the Administrator shall take into account any information you submit demonstrating that the planned duration of CO<sub>2</sub> injection for the project and the planned annual CO<sub>2</sub> injection volumes during the duration of the project are consistent with the purpose of the research and development project.
    - (ii) Any appeal of the Administrator's determination is subject to the provisions of part 78 of this chapter.
    - (iii) A project that the Administrator determines is not eligible for an exemption as a research and development project must submit a proposed MRV plan to EPA within 180 days of the Administrator's determination. You may request one extension of up to an additional 180 days in which to submit the proposed MRV plan.

### § 98.441 Reporting threshold.

- (a) You must report under this subpart if any well or group of wells within your facility injects any amount of CO<sub>2</sub> for long-term containment in subsurface geologic formations. There is no threshold.
- (b) **Request for discontinuation of reporting.** The requirements of § 98.2(i) do not apply to this subpart. Once a well or group of wells is subject to the requirements of this subpart, the owner or operator must continue for each year thereafter to comply with all requirements of this subpart, including the requirement to submit annual reports, until the Administrator has issued a final decision on an owner or operator's request to discontinue reporting.
  - (1) **Timing of request.** The owner or operator of a facility may submit a request to discontinue reporting any time after the well or group of wells is plugged and abandoned in accordance with applicable requirements.

- (2) **Content of request.** A request for discontinuation of reporting must contain either paragraph (b)(2)(i) or (b)(2)(ii) of this section.
- (i) For wells permitted as Class VI under the Underground Injection Control program, a copy of the applicable Underground Injection Control program Director's authorization of site closure.
- (ii) For all other wells, and as an alternative for wells permitted as Class VI under the Underground Injection Control program, a demonstration that current monitoring and model(s) show that the injected CO<sub>2</sub> stream is not expected to migrate in the future in a manner likely to result in surface leakage.
- (3) **Notification.** The Administrator will issue a final decision on the request to discontinue reporting within a reasonable time. Any appeal of the Administrator's final decision is subject to the provisions of part 78 of this chapter.

### § 98.442 GHGs to report.

You must report:

- (a) Mass of CO<sub>2</sub> received.
- (b) Mass of CO<sub>2</sub> injected into the subsurface.
- (c) Mass of CO<sub>2</sub> produced.
- (d) Mass of CO<sub>2</sub> emitted by surface leakage.
- (e) Mass of CO<sub>2</sub> emissions from equipment leaks and vented emissions of CO<sub>2</sub> from surface equipment located between the injection flow meter and the injection wellhead.
- (f) Mass of CO<sub>2</sub> emissions from equipment leaks and vented emissions of CO<sub>2</sub> from surface equipment located between the production flow meter and the production wellhead.
- (g) Mass of CO<sub>2</sub> sequestered in subsurface geologic formations.
- (h) Cumulative mass of CO<sub>2</sub> reported as sequestered in subsurface geologic formations in all years since the facility became subject to reporting requirements under this subpart.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73905, Nov. 29, 2011]

### § 98.443 Calculating CO<sub>2</sub> geologic sequestration.

You must calculate the mass of CO<sub>2</sub> received using CO<sub>2</sub> received equations (Equations RR-1 to RR-3 of this section), unless you follow the procedures in § 98.444(a)(4). You must calculate CO<sub>2</sub> sequestered using injection equations (Equations RR-4 to RR-6 of this section), production/recycling equations (Equations RR-7 to RR-9 of this section), surface leakage equations (Equation RR-10 of this section), and sequestration equations (Equations RR-11 and RR-12 of this section). For your first year of reporting, you must calculate CO<sub>2</sub> sequestered starting from the date set forth in your approved MRV plan.

- (a) You must calculate and report the annual mass of CO<sub>2</sub> received by pipeline using the procedures in paragraphs (a)(1) or (a)(2) of this section and the procedures in paragraph (a)(3) of this section, if applicable.

- (1) For a mass flow meter, you must calculate the total annual mass of CO<sub>2</sub> in a CO<sub>2</sub> stream received in metric tons by multiplying the mass flow by the CO<sub>2</sub> concentration in the flow, according to Equation RR-1 of this section. You must collect these data quarterly. Mass flow and concentration data measurements must be made in accordance with § 98.444.

$$CO_{2T,r} = \sum_{p=1}^4 (Q_{r,p} - S_{r,p}) * C_{CO_{2,p,r}} \quad (\text{Eq. RR-1})$$

where:

CO<sub>2T,r</sub> = Net annual mass of CO<sub>2</sub> received through flow meter r (metric tons).

Q<sub>r,p</sub> = Quarterly mass flow through a receiving flow meter r in quarter p (metric tons).

S<sub>r,p</sub> = Quarterly mass flow through a receiving flow meter r that is redelivered to another facility without being injected into your well in quarter p (metric tons).

C<sub>CO<sub>2</sub>,p,r</sub> = Quarterly CO<sub>2</sub> concentration measurement in flow for flow meter r in quarter p (wt. percent CO<sub>2</sub>, expressed as a decimal fraction).

p = Quarter of the year.

r = Receiving flow meter.

- (2) For a volumetric flow meter, you must calculate the total annual mass of CO<sub>2</sub> in a CO<sub>2</sub> stream received in metric tons by multiplying the volumetric flow at standard conditions by the CO<sub>2</sub> concentration in the flow and the density of CO<sub>2</sub> at standard conditions, according to Equation RR-2 of this section. You must collect these data quarterly. Volumetric flow and concentration data measurements must be made in accordance with § 98.444.

$$CO_{2T,r} = \sum_{p=1}^4 (Q_{r,p} - S_{r,p}) * D * C_{CO_{2,p,r}} \quad (\text{Eq. RR-2})$$

where:

CO<sub>2T,r</sub> = Net annual mass of CO<sub>2</sub> received through flow meter r (metric tons).

Q<sub>r,p</sub> = Quarterly volumetric flow through a receiving flow meter r in quarter p at standard conditions (standard cubic meters).

S<sub>r,p</sub> = Quarterly volumetric flow through a receiving flow meter r that is redelivered to another facility without being injected into your well in quarter p (standard cubic meters).

D = Density of CO<sub>2</sub> at standard conditions (metric tons per standard cubic meter): 0.0018682.

C<sub>CO<sub>2</sub>,p,r</sub> = Quarterly CO<sub>2</sub> concentration measurement in flow for flow meter r in quarter p (vol. percent CO<sub>2</sub>, expressed as a decimal fraction).

p = Quarter of the year.

r = Receiving flow meter.

- (3) If you receive CO<sub>2</sub> through more than one flow meter, you must sum the mass of all CO<sub>2</sub> received in accordance with the procedure specified in Equation RR-3 of this section.

$$\text{CO}_2 = \sum_{r=1}^R \text{CO}_{2T,r} \quad (\text{Eq. RR-3})$$

where:

CO<sub>2</sub> = Total net annual mass of CO<sub>2</sub> received (metric tons).

CO<sub>2T,r</sub> = Net annual mass of CO<sub>2</sub> received (metric tons) as calculated in Equation RR-1 or RR-2 for flow meter r.

r = Receiving flow meter.

- (b) You must calculate and report the annual mass of CO<sub>2</sub> received in containers using the procedures in paragraphs (b)(1) or (b)(2) of this section.

- (1) If you are measuring the mass of contents in a container under the provisions of § 98.444(a)(2)(i), you must calculate the CO<sub>2</sub> received for injection in containers using Equation RR-1 of this section.

where:

CO<sub>2T,r</sub> = Net annual mass of CO<sub>2</sub> received in containers r (metric tons).

C<sub>CO<sub>2</sub>,p,r</sub> = Quarterly CO<sub>2</sub> concentration measurement of contents in containers r in quarter p (wt. percent CO<sub>2</sub>, expressed as a decimal fraction).

Q<sub>r,p</sub> = Quarterly mass of contents in containers r in quarter p (metric tons).

S<sub>r,p</sub> = Quarterly volume of contents in containers r redelivered to another facility without being injected into your well in quarter p (standard cubic meters).

p = Quarter of the year.

r = Containers.

- (2) If you are measuring the volume of contents in a container under the provisions of § 98.444(a)(2)(ii), you must calculate the CO<sub>2</sub> received for injection in containers using Equation RR-2 of this section.

where:

CO<sub>2T,r</sub> = Net annual mass of CO<sub>2</sub> received in containers r (metric tons).



$C_{CO_2,p,r}$  = Quarterly  $CO_2$  concentration measurement of contents in containers  $r$  in quarter  $p$  (vol. percent  $CO_2$ , expressed as a decimal fraction).

$Q_{r,p}$  = Quarterly volume of contents in containers  $r$  in quarter  $p$  (standard cubic meters).

$S_{r,p}$  = Quarterly mass of contents in containers  $r$  redelivered to another facility without being injected into your well in quarter  $p$  (metric tons).

$D$  = Density of the  $CO_2$  received in containers at standard conditions (metric tons per standard cubic meter): 0.0018682.

$p$  = Quarter of the year.

$r$  = Containers.

(c) You must report the annual mass of  $CO_2$  injected in accordance with the procedures specified in paragraphs (c)(1) through (c)(3) of this section.

(1) If you use a mass flow meter to measure the flow of an injected  $CO_2$  stream, you must calculate annually the total mass of  $CO_2$  (in metric tons) in the  $CO_2$  stream injected each year in metric tons by multiplying the mass flow by the  $CO_2$  concentration in the flow, according to Equation RR-4 of this section. Mass flow and concentration data measurements must be made in accordance with § 98.444.

$$CO_{2,u} = \sum_{p=1}^4 Q_{p,u} * C_{CO_2,p,u} \quad (\text{Eq. RR-4})$$

where:

$CO_{2,u}$  = Annual  $CO_2$  mass injected (metric tons) as measured by flow meter  $u$ .

$Q_{p,u}$  = Quarterly mass flow rate measurement for flow meter  $u$  in quarter  $p$  (metric tons per quarter).

$C_{CO_2,p,u}$  = Quarterly  $CO_2$  concentration measurement in flow for flow meter  $u$  in quarter  $p$  (wt. percent  $CO_2$ , expressed as a decimal fraction).

$p$  = Quarter of the year.

$u$  = Flow meter.

(2) If you use a volumetric flow meter to measure the flow of an injected  $CO_2$  stream, you must calculate annually the total mass of  $CO_2$  (in metric tons) in the  $CO_2$  stream injected each year in metric tons by multiplying the volumetric flow at standard conditions by the  $CO_2$  concentration in the flow and the density of  $CO_2$  at standard conditions, according to Equation RR-5 of this section. Volumetric flow and concentration data measurements must be made in accordance with § 98.444.

$$CO_{2,u} = \sum_{p=1}^4 Q_{p,u} * D * C_{CO_{2,p,u}} \quad (\text{Eq. RR-5})$$

where:

$CO_{2,u}$  = Annual  $CO_2$  mass injected (metric tons) as measured by flow meter  $u$ .

$Q_{p,u}$  = Quarterly volumetric flow rate measurement for flow meter  $u$  in quarter  $p$  at standard conditions (standard cubic meters per quarter).

$D$  = Density of  $CO_2$  at standard conditions (metric tons per standard cubic meter): 0.0018682.

$C_{CO_{2,p,u}}$  =  $CO_2$  concentration measurement in flow for flow meter  $u$  in quarter  $p$  (vol. percent  $CO_2$ , expressed as a decimal fraction).

$p$  = Quarter of the year.

$u$  = Flow meter.

- (3) To aggregate injection data for all wells covered under this subpart, you must sum the mass of all  $CO_2$  injected through all injection wells in accordance with the procedure specified in Equation RR-6 of this section.

$$CO_{2I} = \sum_{u=1}^U CO_{2,u} \quad (\text{Eq. RR-6})$$

where:

$CO_{2I}$  = Total annual  $CO_2$  mass injected (metric tons) through all injection wells.

$CO_{2,u}$  = Annual  $CO_2$  mass injected (metric tons) as measured by flow meter  $u$ .

$u$  = Flow meter.

- (d) You must calculate the annual mass of  $CO_2$  produced from oil or gas production wells or from other fluid wells for each separator that sends a stream of gas into a recycle or end use system in accordance with the procedures specified in paragraphs (d)(1) through (d)(3) of this section. You must account for any  $CO_2$  that is produced and not processed through a separator. You must account only for wells that produce the  $CO_2$  that was injected into the well or wells covered by this source category.
- (1) For each gas-liquid separator for which flow is measured using a mass flow meter, you must calculate annually the total mass of  $CO_2$  produced from an oil or other fluid stream in metric tons that is separated from the fluid by multiplying the mass gas flow by the  $CO_2$  concentration in the gas flow, according to Equation RR-7 of this section. You must collect these data quarterly. Mass flow and concentration data measurements must be made in accordance with § 98.444.

$$CO_{2,w} = \sum_{p=1}^4 Q_{p,w} * C_{CO_{2,p,w}} \quad (\text{Eq. RR-7})$$

Where:

$CO_{2,w}$  = Annual  $CO_2$  mass produced (metric tons) through separator w.

$Q_{p,w}$  = Quarterly gas mass flow rate measurement for separator w in quarter p (metric tons).

$C_{CO_{2,p,w}}$  = Quarterly  $CO_2$  concentration measurement in flow for separator w in quarter p (wt. percent  $CO_2$ , expressed as a decimal fraction).

p = Quarter of the year.

w = Separator.

- (2) For each gas-liquid separator for which flow is measured using a volumetric flow meter, you must calculate annually the total mass of  $CO_2$  produced from an oil or other fluid stream in metric tons that is separated from the fluid by multiplying the volumetric gas flow at standard conditions by the  $CO_2$  concentration in the gas flow and the density of  $CO_2$  at standard conditions, according to Equation RR-8 of this section. You must collect these data quarterly. Volumetric flow and concentration data measurements must be made in accordance with § 98.444.

$$CO_{2,w} = \sum_{p=1}^4 Q_{p,w} * D * C_{CO_{2,p,w}} \quad (\text{Eq. RR-8})$$

Where:

$CO_{2,w}$  = Annual  $CO_2$  mass produced (metric tons) through separator w.

$Q_{p,w}$  = Volumetric gas flow rate measurement for separator w in quarter p at standard conditions (standard cubic meters).

D = Density of  $CO_2$  at standard conditions (metric tons per standard cubic meter): 0.0018682.

$C_{CO_{2,p,w}}$  =  $CO_2$  concentration measurement in flow for separator w in quarter p (vol. percent  $CO_2$ , expressed as a decimal fraction).

p = Quarter of the year.

w = Separator.

- (3) To aggregate production data, you must sum the mass of all of the  $CO_2$  separated at each gas-liquid separator in accordance with the procedure specified in Equation RR-9 of this section. You must assume that the total  $CO_2$  measured at the separator(s) represents a percentage of the total  $CO_2$  produced. In order to account for the percentage of  $CO_2$  produced that is estimated to remain with

the produced oil or other fluid, you must multiply the quarterly mass of CO<sub>2</sub> measured at the separator(s) by a percentage estimated using a methodology in your approved MRV plan. If fluids containing CO<sub>2</sub> from injection wells covered under this source category are produced and not processed through a gas-liquid separator, the concentration of CO<sub>2</sub> in the produced fluids must be measured at a flow meter located prior to reinjection or reuse using methods in § 98.444(f)(1). The considerations you intend to use to calculate CO<sub>2</sub> from produced fluids for the mass balance equation must be described in your approved MRV plan in accordance with § 98.448(a)(5).

$$CO_{2P} = (1+X) * \sum_{w=1}^W CO_{2,w} \quad (\text{Eq. RR-9})$$

Where:

CO<sub>2P</sub> = Total annual CO<sub>2</sub> mass produced (metric tons) through all separators in the reporting year.

CO<sub>2,w</sub> = Annual CO<sub>2</sub> mass produced (metric tons) through separator w in the reporting year.

X = Entrained CO<sub>2</sub> in produced oil or other fluid divided by the CO<sub>2</sub> separated through all separators in the reporting year (weight percent CO<sub>2</sub>, expressed as a decimal fraction).

w = Separator.

- (e) You must report the annual mass of CO<sub>2</sub> that is emitted by surface leakage in accordance with your approved MRV plan. You must calculate the total annual mass of CO<sub>2</sub> emitted from all leakage pathways in accordance with the procedure specified in Equation RR-10 of this section.

$$CO_{2E} = \sum_{x=1}^X CO_{2,x} \quad (\text{Eq. RR-10})$$

where:

CO<sub>2E</sub> = Total annual CO<sub>2</sub> mass emitted by surface leakage (metric tons) in the reporting year.

CO<sub>2,x</sub> = Annual CO<sub>2</sub> mass emitted (metric tons) at leakage pathway x in the reporting year.

x = Leakage pathway.

- (f) You must report the annual mass of CO<sub>2</sub> that is sequestered in subsurface geologic formations in the reporting year in accordance with the procedures specified in paragraphs (f)(1) and (f)(2) of this section.

- (1) If you are actively producing oil or natural gas or if you are producing any other fluids, you must calculate the annual mass of CO<sub>2</sub> that is sequestered in the underground subsurface formation in the reporting year in accordance with the procedure specified in Equation RR-11 of this section.

$$CO_2 = CO_{2I} - CO_{2P} - CO_{2E} - CO_{2FI} - CO_{2FP} \quad (\text{Eq. RR-11})$$

where:

$CO_2$  = Total annual  $CO_2$  mass sequestered in subsurface geologic formations (metric tons) at the facility in the reporting year.

$CO_{2I}$  = Total annual  $CO_2$  mass injected (metric tons) in the well or group of wells covered by this source category in the reporting year.

$CO_{2P}$  = Total annual  $CO_2$  mass produced (metric tons) in the reporting year.

$CO_{2E}$  = Total annual  $CO_2$  mass emitted (metric tons) by surface leakage in the reporting year.

$CO_{2FI}$  = Total annual  $CO_2$  mass emitted (metric tons) from equipment leaks and vented emissions of  $CO_2$  from equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead, for which a calculation procedure is provided in subpart W of this part.

$CO_{2FP}$  = Total annual  $CO_2$  mass emitted (metric tons) from equipment leaks and vented emissions of  $CO_2$  from equipment located on the surface between the production wellhead and the flow meter used to measure production quantity, for which a calculation procedure is provided in subpart W of this part.

- (2) If you are not actively producing oil or natural gas or any other fluids, you must calculate the annual mass of  $CO_2$  that is sequestered in subsurface geologic formations in the reporting year in accordance with the procedures specified in Equation RR-12 of this section.

$$CO_2 = CO_{2I} - CO_{2E} - CO_{2FI} \quad (\text{Eq. RR-12})$$

where:

$CO_2$  = Total annual  $CO_2$  mass sequestered in subsurface geologic formations (metric tons) at the facility in the reporting year.

$CO_{2I}$  = Total annual  $CO_2$  mass injected (metric tons) in the well or group of wells covered by this source category in the reporting year.

$CO_{2E}$  = Total annual  $CO_2$  mass emitted (metric tons) by surface leakage in the reporting year.

$CO_{2FI}$  = Total annual  $CO_2$  mass emitted (metric tons) from equipment leaks and vented emissions of  $CO_2$  from equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead, for which a calculation procedure is provided in subpart W of this part.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73906, Nov. 29, 2011; 78 FR 71978, Nov. 29, 2013]

## § 98.444 Monitoring and QA/QC requirements.

(a)  $CO_2$  received.

- (1) Except as provided in paragraph (a)(4) of this section, you must determine the quarterly flow rate of  $CO_2$  received by pipeline by following the most appropriate of the following procedures:

- (i) You may measure flow rate at the receiving custody transfer meter prior to any subsequent processing operations at the facility and collect the flow rate quarterly.

- (ii) If you took ownership of the CO<sub>2</sub> in a commercial transaction, you may use the quarterly flow rate data from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.
    - (iii) If you inject CO<sub>2</sub> received from a production process unit that is part of your facility, you may use the quarterly CO<sub>2</sub> flow rate that was measured at the equivalent of a custody transfer meter following procedures provided in subpart PP of this part. To be the equivalent of a custody transfer meter, a meter must measure the flow of CO<sub>2</sub> being transported to an injection well to the same degree of accuracy as a meter used for commercial transactions.
  - (2) Except as provided in paragraph (a)(4) of this section, you must determine the quarterly mass or volume of contents in all containers if you receive CO<sub>2</sub> in containers by following the most appropriate of the following procedures:
    - (i) You may measure the mass of contents of containers summed quarterly using weigh bills, scales, or load cells.
    - (ii) You may determine the volume of the contents of containers summed quarterly.
    - (iii) If you took ownership of the CO<sub>2</sub> in a commercial transaction, you may use the quarterly mass or volume of contents from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.
  - (3) Except as provided in paragraph (a)(4) of this section, you must determine a quarterly concentration of the CO<sub>2</sub> received that is representative of all CO<sub>2</sub> received in that quarter by following the most appropriate of the following procedures:
    - (i) You may sample the CO<sub>2</sub> stream at least once per quarter at the point of receipt and measure its CO<sub>2</sub> concentration.
    - (ii) If you took ownership of the CO<sub>2</sub> in a commercial transaction for which the sales contract was contingent on CO<sub>2</sub> concentration, and if the supplier of the CO<sub>2</sub> sampled the CO<sub>2</sub> stream in a quarter and measured its concentration per the sales contract terms, you may use the CO<sub>2</sub> concentration data from the sales contract for that quarter.
    - (iii) If you inject CO<sub>2</sub> from a production process unit that is part of your facility, you may report the quarterly CO<sub>2</sub> concentration of the CO<sub>2</sub> stream supplied that was measured following the procedures provided in subpart PP of this part.
  - (4) If the CO<sub>2</sub> you receive is wholly injected and is not mixed with any other supply of CO<sub>2</sub>, you may report the annual mass of CO<sub>2</sub> injected that you determined following the requirements under paragraph (b) of this section as the total annual mass of CO<sub>2</sub> received instead of using Equation RR-1 or RR-2 of this subpart to calculate CO<sub>2</sub> received.
  - (5) You must assume that the CO<sub>2</sub> you receive meets the definition of a CO<sub>2</sub> stream unless you can trace it through written records to a source other than a CO<sub>2</sub> stream.
- (b) **CO<sub>2</sub> injected.**
- (1) You must select a point or points of measurement at which the CO<sub>2</sub> stream(s) is representative of the CO<sub>2</sub> stream(s) being injected. You may use as the point or points of measurement the location(s) of the flow meter(s) used to comply with the flow monitoring and reporting provisions in your Underground Injection Control permit.

- (2) You must measure flow rate of CO<sub>2</sub> injected with a flow meter and collect the flow rate quarterly.
- (3) You must sample the injected CO<sub>2</sub> stream at least once per quarter immediately upstream or downstream of the flow meter used to measure flow rate of that CO<sub>2</sub> stream and measure the CO<sub>2</sub> concentration of the sample.

(c) **CO<sub>2</sub> produced.**

- (1) The point of measurement for the quantity of CO<sub>2</sub> produced from oil or other fluid production wells is a flow meter directly downstream of each separator that sends a stream of gas into a recycle or end use system.
- (2) You must sample the produced gas stream at least once per quarter immediately upstream or downstream of the flow meter used to measure flow rate of that gas stream and measure the CO<sub>2</sub> concentration of the sample.
- (3) You must measure flow rate of gas produced with a flow meter and collect the flow rate quarterly.

(d) **CO<sub>2</sub> emissions from equipment leaks and vented emissions of CO<sub>2</sub>.** If you have equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead or between the flow meter used to measure production quantity and the production wellhead, you must follow the monitoring and QA/QC requirements specified in subpart W of this part for the equipment.

(e) **Measurement devices.**

- (1) All flow meters must be operated continuously except as necessary for maintenance and calibration.
- (2) You must calibrate all flow meters used to measure quantities reported in § 98.446 according to the calibration and accuracy requirements in § 98.3(i).
- (3) You must operate all measurement devices according to one of the following. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or an industry standard practice. Consensus-based standards organizations include, but are not limited to, the following: ASTM International, the American National Standards Institute (ANSI), the American Gas Association (AGA), the American Society of Mechanical Engineers (ASME), the American Petroleum Institute (API), and the North American Energy Standards Board (NAESB).
- (4) You must ensure that any flow meter calibrations performed are National Institute of Standards and Technology (NIST) traceable.

(f) **General.**

- (1) If you measure the concentration of any CO<sub>2</sub> quantity for reporting, you must measure according to one of the following. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or an industry standard practice.
- (2) You must convert all measured volumes of CO<sub>2</sub> to the following standard industry temperature and pressure conditions for use in Equations RR-2, RR-5 and RR-8 of this subpart: Standard cubic meters at a temperature of 60 degrees Fahrenheit and at an absolute pressure of 1 atmosphere.
- (3) For 2011, you may follow the provisions of § 98.3(d)(1) through (2) for best available monitoring methods only for parameters required by paragraphs (a) and (b) of § 98.443 rather than follow the monitoring requirements of paragraph (a) of this section. For purposes of this subpart, any reference to the year 2010 in § 98.3(d)(1) through (2) shall mean 2011.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73906, Nov. 29, 2011]

## § 98.445 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG quantities calculations is required. Whenever the monitoring procedures cannot be followed, you must use the following missing data procedures:

- (a) A quarterly flow rate of CO<sub>2</sub> received that is missing must be estimated as follows:
  - (1) Another calculation methodology listed in § 98.444(a)(1) must be used if possible.
  - (2) If another method listed in § 98.444(a)(1) cannot be used, a quarterly flow rate value that is missing must be estimated using a representative flow rate value from the nearest previous time period.
- (b) A quarterly mass or volume of contents in containers received that is missing must be estimated as follows:
  - (1) Another calculation methodology listed in § 98.444(a)(2) must be used if possible.
  - (2) If another method listed in § 98.444(a)(2) cannot be used, a quarterly mass or volume value that is missing must be estimated using a representative mass or volume value from the nearest previous time period.
- (c) A quarterly CO<sub>2</sub> concentration of a CO<sub>2</sub> stream received that is missing must be estimated as follows:
  - (1) Another calculation methodology listed in § 98.444(a)(3) must be used if possible.
  - (2) If another method listed in § 98.444(a)(3) cannot be used, a quarterly concentration value that is missing must be estimated using a representative concentration value from the nearest previous time period.
- (d) A quarterly quantity of CO<sub>2</sub> injected that is missing must be estimated using a representative quantity of CO<sub>2</sub> injected from the nearest previous period of time at a similar injection pressure.
- (e) For any values associated with CO<sub>2</sub> emissions from equipment leaks and vented emissions of CO<sub>2</sub> from surface equipment at the facility that are reported in this subpart, missing data estimation procedures should be followed in accordance with those specified in subpart W of this part.
- (f) The quarterly quantity of CO<sub>2</sub> produced from subsurface geologic formations that is missing must be estimated using a representative quantity of CO<sub>2</sub> produced from the nearest previous period of time.
- (g) You must estimate the mass of CO<sub>2</sub> emitted by surface leakage that is missing as required by your approved MRV plan.
- (h) You must estimate other missing data as required by your approved MRV plan.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73906, Nov. 29, 2011]

## § 98.446 Data reporting requirements.

In addition to the information required by § 98.3(c), report the information listed in this section.

- (a) If you receive CO<sub>2</sub> by pipeline, report the following for each receiving flow meter:
  - (1) The total net mass of CO<sub>2</sub> received (metric tons) annually.



- (2) If a volumetric flow meter is used to receive CO<sub>2</sub> report the following unless you reported yes to paragraph (a)(4) of this section:
  - (i) The volumetric flow through a receiving flow meter at standard conditions (in standard cubic meters) in each quarter.
  - (ii) The volumetric flow through a receiving flow meter that is redelivered to another facility without being injected into your well (in standard cubic meters) in each quarter.
  - (iii) The CO<sub>2</sub> concentration in the flow (volume percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
- (3) If a mass flow meter is used to receive CO<sub>2</sub> report the following unless you reported yes to paragraph (a)(4) of this section:
  - (i) The mass flow through a receiving flow meter (in metric tons) in each quarter.
  - (ii) The mass flow through a receiving flow meter that is redelivered to another facility without being injected into your well (in metric tons) in each quarter.
  - (iii) The CO<sub>2</sub> concentration in the flow (weight percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
- (4) If the CO<sub>2</sub> received is wholly injected and not mixed with any other supply of CO<sub>2</sub>, report whether you followed the procedures in § 98.444(a)(4).
- (5) The standard or method used to calculate each value in paragraphs (a)(2) through (a)(3) of this section.
- (6) The number of times in the reporting year for which substitute data procedures were used to calculate values reported in paragraphs (a)(2) through (a)(3) of this section.
- (7) Whether the flow meter is mass or volumetric.
- (8) A numerical identifier for the flow meter.
- (b) If you receive CO<sub>2</sub> in containers, report:
  - (1) The mass (in metric tons) or volume at standard conditions (in standard cubic meters) of contents in containers received in each quarter.
  - (2) The concentration of CO<sub>2</sub> of contents in containers (volume or wt. percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
  - (3) The mass (in metric tons) or volume (in standard cubic meters) of contents in containers that is redelivered to another facility without being injected into your well in each quarter.
  - (4) The net mass of CO<sub>2</sub> received (in metric tons) annually.
  - (5) The standard or method used to calculate each value in paragraphs (b)(1), (b)(2), and (b)(3) of this section.
  - (6) The number of times in the reporting year for which substitute data procedures were used to calculate values reported in paragraphs (b)(1) and (b)(2) of this section.
- (c) If you use more than one receiving flow meter, report the total net mass of CO<sub>2</sub> received (metric tons) through all flow meters annually.

- (d) The source of the CO<sub>2</sub> received according to the following categories:
  - (1) CO<sub>2</sub> production wells.
  - (2) Electric generating unit.
  - (3) Ethanol plant.
  - (4) Pulp and paper mill.
  - (5) Natural gas processing.
  - (6) Gasification operations.
  - (7) Other anthropogenic source.
  - (8) Discontinued enhanced oil and gas recovery project.
  - (9) Unknown.
- (e) Report the date that you began collecting data for calculating total amount sequestered according to § 98.448(a)(7) of this subpart.
- (f) Report the following. If the date specified in paragraph (e) of this section is during the reporting year for this annual report, report the following starting on the date specified in paragraph (e) of this section.
  - (1) For each injection flow meter (mass or volumetric), report:
    - (i) The mass of CO<sub>2</sub> injected (metric tons) annually.
    - (ii) The CO<sub>2</sub> concentration in flow (volume or weight percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
    - (iii) If a volumetric flow meter is used, the volumetric flow rate at standard conditions (in standard cubic meters) in each quarter.
    - (iv) If a mass flow meter is used, the mass flow rate (in metric tons) in each quarter.
    - (v) A numerical identifier for the flow meter.
    - (vi) Whether the flow meter is mass or volumetric.
    - (vii) The standard used to calculate each value in paragraphs (f)(1)(ii) through (f)(1)(iv) of this section.
    - (viii) The number of times in the reporting year for which substitute data procedures were used to calculate values reported in paragraphs (f)(1)(ii) through (f)(1)(iv) of this section.
    - (ix) The location of the flow meter.
  - (2) The total CO<sub>2</sub> injected (metric tons) in the reporting year as calculated in Equation RR-6 of this subpart.
  - (3) For CO<sub>2</sub> emissions from equipment leaks and vented emissions of CO<sub>2</sub>, report the following:
    - (i) The mass of CO<sub>2</sub> emitted (in metric tons) annually from equipment leaks and vented emissions of CO<sub>2</sub> from equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead.

- (ii) The mass of CO<sub>2</sub> emitted (in metric tons) annually from equipment leaks and vented emissions of CO<sub>2</sub> from equipment located on the surface between the production wellhead and the flow meter used to measure production quantity.
- (4) For each separator flow meter (mass or volumetric), report:
  - (i) CO<sub>2</sub> mass produced (metric tons) annually.
  - (ii) CO<sub>2</sub> concentration in flow (volume or weight percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
  - (iii) If a volumetric flow meter is used, volumetric flow rate at standard conditions (standard cubic meters) in each quarter.
  - (iv) If a mass flow meter, mass flow rate (metric tons) in each quarter.
  - (v) A numerical identifier for the flow meter.
  - (vi) Whether the flow meter is mass or volumetric.
  - (vii) The standard used to calculate each value in paragraphs (f)(4)(ii) through (f)(4)(iv) of this section.
  - (viii) The number of times in the reporting year for which substitute data procedures were used to calculate values reported in paragraphs (f)(4)(ii) through (f)(4)(iv) of this section.
- (5) The entrained CO<sub>2</sub> in produced oil or other fluid divided by the CO<sub>2</sub> separated through all separators in the reporting year (weight percent CO<sub>2</sub> expressed as a decimal fraction) used as the value for X in Equation RR-9 of this subpart and as determined according to your EPA-approved MRV plan.
- (6) Annual CO<sub>2</sub> produced in the reporting year as calculated in Equation RR-9 of this subpart.
- (7) For each leakage pathway through which CO<sub>2</sub> emissions occurred, report:
  - (i) A numerical identifier for the leakage pathway.
  - (ii) The CO<sub>2</sub> (metric tons) emitted through that pathway in the reporting year.
- (8) Annual CO<sub>2</sub> mass emitted (metric tons) by surface leakage in the reporting year as calculated by Equation RR-10 of this subpart.
- (9) Annual CO<sub>2</sub> (metric tons) sequestered in subsurface geologic formations in the reporting year as calculated by Equation RR-11 or RR-12 of this subpart.
- (10) Cumulative mass of CO<sub>2</sub> (metric tons) reported as sequestered in subsurface geologic formations in all years since the well or group of wells became subject to reporting requirements under this subpart.
- (11) Date that the most recent MRV plan was approved by EPA and the MRV plan approval number that was issued by EPA.
- (12) An annual monitoring report that contains the following components:
  - (i) A narrative history of the monitoring efforts conducted over the previous calendar year, including a listing of all monitoring equipment that was operated, its period of operation, and any relevant tests or surveys that were conducted.

- (ii) A description of any changes to the monitoring program that you concluded were not material changes warranting submission of a revised MRV plan under § 98.448(d).
  - (iii) A narrative history of any monitoring anomalies that were detected in the previous calendar year and how they were investigated and resolved.
  - (iv) A description of any surface leakages of CO<sub>2</sub>, including a discussion of all methodologies and technologies involved in detecting and quantifying the surface leakages and any assumptions and uncertainties involved in calculating the amount of CO<sub>2</sub> emitted.
- (13) If a well is permitted under the Underground Injection Control program, for each injection well, report:
- (i) The well identification number used for the Underground Injection Control permit.
  - (ii) The Underground Injection Control permit class.
- (14) If an offshore well is not subject to the Safe Drinking Water Act, for each injection well, report any well identification number and any identification number used for the legal instrument authorizing geologic sequestration.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73906, Nov. 29, 2011; 78 FR 71979, Nov. 29, 2013]

## § 98.447 Records that must be retained.

- (a) You must follow the record retention requirements specified by § 98.3(g). In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a)(1) through (7) of this section, as applicable. You must retain all required records for at least 3 years.
- (1) Quarterly records of CO<sub>2</sub> received, including mass flow rate of contents of containers (mass or volumetric) at standard conditions and operating conditions, operating temperature and pressure, and concentration of these streams.
  - (2) Quarterly records of produced CO<sub>2</sub>, including mass flow or volumetric flow at standard conditions and operating conditions, operating temperature and pressure, and concentration of these streams.
  - (3) Quarterly records of injected CO<sub>2</sub> including mass flow or volumetric flow at standard conditions and operating conditions, operating temperature and pressure, and concentration of these streams.
  - (4) Annual records of information used to calculate the CO<sub>2</sub> emitted by surface leakage from leakage pathways.
  - (5) Annual records of information used to calculate the CO<sub>2</sub> emitted from equipment leaks and vented emissions of CO<sub>2</sub> from equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead.
  - (6) Annual records of information used to calculate the CO<sub>2</sub> emitted from equipment leaks and vented emissions of CO<sub>2</sub> from equipment located on the surface between the production wellhead and the flow meter used to measure production quantity.
  - (7) Any other records as specified for retention in your EPA-approved MRV plan.
- (b) You must complete your monitoring plans, as described in § 98.3(g)(5), by April 1 of the year you begin collecting data.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73906, Nov. 29, 2011]

**§ 98.448 Geologic sequestration monitoring, reporting, and verification (MRV) plan.**

- (a) **Contents of MRV plan.** You must develop and submit to the Administrator a proposed MRV plan for monitoring, reporting, and verification of geologic sequestration at your facility. Your proposed MRV plan must contain the following components:
- (1) Delineation of the maximum monitoring area and the active monitoring areas. The first period for your active monitoring area will begin from the date determined in your MRV plan through the date at which the plan calls for the first expansion of the monitoring area. The length of each monitoring period can be any time interval chosen by you that is greater than 1 year.
  - (2) Identification of potential surface leakage pathways for CO<sub>2</sub> in the maximum monitoring area and the likelihood, magnitude, and timing, of surface leakage of CO<sub>2</sub> through these pathways.
  - (3) A strategy for detecting and quantifying any surface leakage of CO<sub>2</sub>.
  - (4) A strategy for establishing the expected baselines for monitoring CO<sub>2</sub> surface leakage.
  - (5) A summary of the considerations you intend to use to calculate site-specific variables for the mass balance equation. This includes, but is not limited to, considerations for calculating CO<sub>2</sub> emissions from equipment leaks and vented emissions of CO<sub>2</sub> between the injection flow meter and injection well and/or the production flow meter and production well, and considerations for calculating CO<sub>2</sub> in produced fluids.
  - (6) If a well is permitted under the Underground Injection Control program, for each injection well, report the well identification number used for the Underground Injection Control permit and the Underground Injection Control permit class. If the well is not yet permitted, and you have applied for an Underground Injection Control permit, report the well identification numbers in the permit application. If an offshore well is not subject to the Safe Drinking Water Act, for each injection well, report any well identification number and any identification number used for the legal instrument authorizing geologic sequestration. If you are submitting your Underground Injection Control permit application as part of your proposed MRV plan, you must notify EPA when the permit has been approved. If you are an offshore facility not subject to the Safe Drinking Water Act, and are submitting your application for the legal instrument authorizing geologic sequestration as part of your proposed MRV plan, you must notify EPA when the legal instrument authorizing geologic sequestration has been approved.
  - (7) Proposed date to begin collecting data for calculating total amount sequestered according to equation RR-11 or RR-12 of this subpart. This date must be after expected baselines as required by paragraph (a)(4) of this section are established and the leakage detection and quantification strategy as required by paragraph (a)(3) of this section is implemented in the initial AMA.
- (b) **Timing.** You must submit a proposed MRV plan to EPA according to the following schedule:
- (1) You must submit a proposed MRV plan to EPA by June 30, 2011 if you were issued a final Underground Injection Control permit authorizing the injection of CO<sub>2</sub> into the subsurface on or before December 31, 2010. You will be allowed to request one extension of up to an additional 180 days in which to submit your proposed MRV plan.

- (2) You must submit a proposed MRV plan to EPA within 180 days of receiving a final Underground Injection Control permit authorizing the injection of CO<sub>2</sub> into the subsurface. If your facility is an offshore facility not subject to the Safe Drinking Water Act, you must submit a proposed MRV plan to EPA within 180 days of receiving authorization to begin geologic sequestration of CO<sub>2</sub>. You will be allowed to request one extension of the submittal date of up to an additional 180 days.
  - (3) If you are injecting a CO<sub>2</sub> stream in subsurface geologic formations to enhance the recovery of oil or natural gas and you are not permitted as Class VI under the Underground Injection Control program, you may opt to submit an MRV plan at any time.
  - (4) If EPA determines that your proposed MRV plan is incomplete, you must submit an updated MRV plan within 45 days of EPA notification, unless otherwise specified by EPA.
- (c) **Final MRV plan.** The Administrator will issue a final MRV plan within a reasonable period of time. The Administrator's final MRV plan is subject to the provisions of part 78 of this chapter. Once the MRV plan is final and no longer subject to administrative appeal under part 78 of this chapter, you must implement the plan starting on the day after the day on which the plan becomes final and is no longer subject to such appeal.
- (d) **MRV plan revisions.** You must revise and submit the MRV plan within 180 days to the Administrator for approval if any of the following in paragraphs (d)(1) through (d)(4) of this section applies. You must include the reason(s) for the revisions in your submittal.
- (1) A material change was made to monitoring and/or operational parameters that was not anticipated in the original MRV plan. Examples of material changes include but are not limited to: Large changes in the volume of CO<sub>2</sub> injected; the construction of new injection wells not identified in the MRV plan; failures of the monitoring system including monitoring system sensitivity, performance, location, or baseline; changes to surface land use that affects baseline or operational conditions; observed plume location that differs significantly from the predicted plume area used for developing the MRV plan; a change in the maximum monitoring area or active monitoring area; or a change in monitoring technology that would result in coverage or detection capability different from the MRV plan.
  - (2) A change in the permit class of your Underground Injection Control permit.
  - (3) If you are notified by EPA of substantive errors in your MRV plan or monitoring report.
  - (4) You choose to revise your MRV plan for any other reason in any reporting year.
- (e) **Revised MRV plan.** The requirements of paragraph (c) of this section apply to any submission of a revised MRV plan. You must continue reporting under your currently approved plan while awaiting approval of a revised MRV plan.
- (f) **Format.** Each proposed MRV plan or revision and each annual report must be submitted electronically in a format specified by the Administrator.
- (g) **Certificate of representation.** You must submit a certificate of representation according to the provisions in § 98.4 at least 60 days before submission of your MRV plan, your research and development exemption request, your MRV plan submission extension request, or your initial annual report under this part, whichever is earlier.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73907, Nov. 29, 2011]

## § 98.449 Definitions.

Except as provided below, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Active monitoring area** is the area that will be monitored over a specific time interval from the first year of the period (n) to the last year in the period (t). The boundary of the active monitoring area is established by superimposing two areas:

- (1) The area projected to contain the free phase CO<sub>2</sub> plume at the end of year t, plus an all around buffer zone of one-half mile or greater if known leakage pathways extend laterally more than one-half mile.
- (2) The area projected to contain the free phase CO<sub>2</sub> plume at the end of year t + 5.

**CO<sub>2</sub> received** means the CO<sub>2</sub> stream that you receive to be injected for the first time into a well on your facility that is covered by this subpart. CO<sub>2</sub> received includes, but is not limited to, a CO<sub>2</sub> stream from a production process unit inside your facility and a CO<sub>2</sub> stream that was injected into a well on another facility, removed from a discontinued enhanced oil or natural gas or other production well, and transferred to your facility.

**Equipment leak** means those emissions that could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening.

**Expected baseline** is the anticipated value of a monitored parameter that is compared to the measured monitored parameter.

**Maximum monitoring area** means the area that must be monitored under this regulation and is defined as equal to or greater than the area expected to contain the free phase CO<sub>2</sub> plume until the CO<sub>2</sub> plume has stabilized plus an all-around buffer zone of at least one-half mile.

**Offshore** means seaward of the terrestrial borders of the United States, including waters subject to the ebb and flow of the tide, as well as adjacent bays, lakes or other normally standing waters, and extending to the outer boundaries of the jurisdiction and control of the United States under the Outer Continental Shelf Lands Act.

**Research and development project** means a project for the purpose of investigating practices, monitoring techniques, or injection verification, or engaging in other applied research, that will enable safe and effective long-term containment of a CO<sub>2</sub> stream in subsurface geologic formations, including research and short duration CO<sub>2</sub> injection tests conducted as a precursor to long-term storage.

**Separator** means a vessel in which streams of multiple phases are gravity separated into individual streams of single phase.

**Surface leakage** means the movement of the injected CO<sub>2</sub> stream from the injection zone to the surface, and into the atmosphere, indoor air, oceans, or surface water.

**Underground Injection Control permit** means a permit issued under the authority of Part C of the Safe Drinking Water Act at 42 U.S.C. 300h *et seq.*

**Underground Injection Control program** means the program responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal for purposes of protecting underground sources of drinking water from endangerment pursuant to Part C of the Safe Drinking Water Act at 42 U.S.C. 300h *et seq.*

**Vented emissions** means intentional or designed releases of CH<sub>4</sub> or CO<sub>2</sub> containing natural gas or hydrocarbon gas (not including stationary combustion flue gas), including process designed flow to the atmosphere through seals or vent pipes, equipment blowdown for maintenance, and direct venting of gas used to power equipment (such as pneumatic devices).

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73907, Nov. 29, 2011; 89 FR 31944, Apr. 25, 2024]

## Subpart SS—Electrical Equipment Manufacture or Refurbishment

**Source:** 89 FR 31944, Apr. 25, 2024, unless otherwise noted.

### § 98.450 Definition of the source category.

The electrical equipment manufacturing or refurbishment category consists of processes that manufacture or refurbish gas-insulated substations, circuit breakers, other switchgear, gas-insulated lines, or power transformers (including gas-containing components of such equipment) containing fluorinated GHGs, including but not limited to sulfur-hexafluoride (SF<sub>6</sub>) and perfluorocarbons (PFCs). The processes include equipment testing, installation, manufacturing, decommissioning and disposal, refurbishing, and storage in gas cylinders and other containers.

### § 98.451 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an electrical equipment manufacturing or refurbishing process and the facility meets the requirements of § 98.2(a)(2). To calculate total annual GHG emissions for comparison to the 25,000 metric ton CO<sub>2</sub>e per year emission threshold in § 98.2(a)(2), follow the requirements of § 98.2(b), with one exception. Instead of following the requirement of § 98.453 to calculate emissions from electrical equipment manufacture or refurbishment, you must calculate emissions of each fluorinated GHG that is a component of a reportable insulating gas and then sum the emissions of each fluorinated GHG resulting from manufacturing and refurbishing electrical equipment using equation SS-1 to this section.

$$E = \sum_j \sum_i P_j * GHG_{i,w} * GWP_i * EF * 0.000453592 \quad (\text{Eq. SS-1})$$

Where:

E = Annual production process emissions for threshold applicability purposes (metric tons CO<sub>2</sub>e).

P<sub>j</sub> = Total annual purchases of reportable insulating gas j (lbs).

GHG<sub>i,w</sub> = The weight fraction of fluorinated GHG i in reportable insulating gas j if reportable insulating gas j is a gas mixture. If not a mixture, use 1.

GWP<sub>i</sub> = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

EF = Emission factor for electrical transmission and distribution equipment (lbs emitted/lbs purchased). For all gases, use an emission factor of 0.1.

i = Fluorinated GHG contained in the electrical transmission and distribution equipment.



0.000453592 = Conversion factor from lbs to metric tons.

## § 98.452 GHGs to report.

- (a) You must report emissions of each fluorinated GHG, including but not limited to SF<sub>6</sub> and PFCs, at the facility level, except you are not required to report emissions of fluorinated GHGs that are components of insulating gases whose weighted average GWPs, as calculated in equation SS-2 to this section, are less than or equal to one. You are, however, required to report certain quantities of insulating gases whose weighted average GWPs are less than or equal to one as specified in § 98.456(f), (g), (k) and (q) through (s). Annual emissions from the facility must include fluorinated GHG emissions from equipment that is installed at an off-site electric power transmission or distribution location whenever emissions from installation activities (e.g., filling) occur before the title to the equipment is transferred to the electric power transmission or distribution entity.

$$GWP_j = \sum_i GHG_{i,w} * GWP_i \quad (\text{Eq. SS-2})$$

Where:

$GWP_j$  = Weighted average GWP of insulating gas j.

$GHG_{i,w}$  = The weight fraction of GHG i in insulating gas j, expressed as a decimal. fraction. If GHG i is not part of a gas mixture, use a value of 1.0.

$GWP_i$  = Gas-appropriate GWP as provided in table A-1 to subpart A of this part.

i = GHG contained in the electrical transmission and distribution equipment.

- (b) You must report CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> emissions from each stationary combustion unit. You must calculate and report these emissions under subpart C of this part by following the requirements of subpart C of this part.

## § 98.453 Calculating GHG emissions.

- (a) For each electrical equipment manufacturer or refurbisher, estimate the annual emissions of each fluorinated GHG that is a component of any reportable insulating gas using the mass-balance approach in equation SS-3 to this section:

$$\text{User emissions}_i = \sum_j GHG_{i,w} *$$

[(Decrease in Inventory of Reportable Insulating Gas j Inventory) + (Acquisitions of Reportable

Insulating Gas j) – (Disbursements of Reportable Insulating Gas j)] \quad (\text{Eq. SS-3})

Where:

User emissions<sub>i</sub> = Annual emissions of each fluorinated GHG i (pounds).

$GHG_{i,w}$  = The weight fraction of fluorinated GHG i in reportable insulating gas j if insulating gas j is a gas mixture, expressed as a decimal fraction. If fluorinated GHG i is not part of a gas mixture, use a value of 1.0.

Decrease in Inventory of Reportable Insulating Gas j Inventory = (Pounds of reportable insulating gas j stored in containers at the beginning of the year) – (Pounds of reportable insulating gas j stored in containers at the end of the year).

Acquisitions of Reportable Insulating Gas j = (Pounds of reportable insulating gas j purchased from chemical producers or suppliers in bulk) + (Pounds of reportable insulating gas j returned by equipment users) + (Pounds of reportable insulating gas j returned to site after off-site recycling).

Disbursements of Reportable Insulating Gas j = (Pounds of reportable insulating gas j contained in new equipment delivered to customers) + (Pounds of reportable insulating gas j delivered to equipment users in containers) + (Pounds of reportable insulating gas j returned to suppliers) + (Pounds of reportable insulating gas j sent off site for recycling) + (Pounds of reportable insulating gas j sent off-site for destruction).

(b) [Reserved]

(c) Estimate the disbursements of reportable insulating gas j sent to customers in new equipment or cylinders or sent off-site for other purposes including for recycling, for destruction or to be returned to suppliers using equation SS-4 to this section:

$$D_{\text{GHG}} = \sum_{p=1}^n Q_p \quad (\text{Eq. SS-4})$$

Where:

$D_{\text{GHG}}$  = The annual disbursement of reportable insulating gas j sent to customers in new equipment or cylinders or sent off-site for other purposes including for recycling, for destruction or to be returned to suppliers.

$Q_p$  = The mass of reportable insulating gas j charged into equipment or containers over the period p sent to customers or sent off-site for other purposes including for recycling, for destruction or to be returned to suppliers.

n = The number of periods in the year.

(d) Estimate the mass of each insulating gas j disbursed to customers in new equipment or cylinders over the period p by monitoring the mass flow of each insulating gas j into the new equipment or cylinders using a flowmeter, or by weighing containers before and after gas from containers is used to fill equipment or cylinders, or by using the nameplate capacity of the equipment.

(e) If the mass of insulating gas j disbursed to customers in new equipment or cylinders over the period p is estimated by weighing containers before and after gas from containers is used to fill equipment or cylinders, estimate this quantity using equation SS-5 to this section:

$$Q_p = M_B - M_E - E_L \quad (\text{Eq. SS-5})$$

Where:

$Q_p$  = The mass of insulating gas j charged into equipment or containers over the period p sent to customers or sent off-site for other purposes including for recycling, for destruction or to be returned to suppliers.

$M_B$  = The mass of the contents of the containers used to fill equipment or cylinders at the beginning of period p.

$M_E$  = The mass of the contents of the containers used to fill equipment or cylinders at the end of period p.

$E_L$  = The mass of insulating gas j emitted during the period p downstream of the containers used to fill equipment or cylinders and in cases where a flowmeter is used, downstream of the flowmeter during the period p (e.g., emissions from hoses or other flow lines that connect the container to the equipment or cylinder that is being filled).

- (f) If the mass of insulating gas j disbursed to customers in new equipment or cylinders over the period p is determined using a flowmeter, estimate this quantity using equation SS-6 to this section:

$$Q_p = M_{mr} - E_L \quad (\text{Eq. SS-6})$$

Where:

$Q_p$  = The mass of insulating gas j charged into equipment or containers over the period p sent to customers or sent off-site for other purposes including for recycling, for destruction or to be returned to suppliers.

$M_{mr}$  = The mass of insulating gas j that has flowed through the flowmeter during the period p.

$E_L$  = The mass of insulating gas j emitted during the period p downstream of the containers used to fill equipment or cylinders and in cases where a flowmeter is used, downstream of the flowmeter during the period p (e.g., emissions from hoses or other flow lines that connect the container to the equipment that is being filled).

- (g) Estimate the mass of insulating gas j emitted during the period p downstream of the containers used to fill equipment or cylinders (e.g., emissions from hoses or other flow lines that connect the container to the equipment or cylinder that is being filled) using equation SS-7 to this section:

$$E_L = \sum_{j=0}^n F_{Ci} * EF_{Ci} \quad (\text{Eq. SS-7})$$

Where:

$E_L$  = The mass of insulating gas j emitted during the period p downstream of the containers used to fill equipment or cylinders and in cases where a flowmeter is used, downstream of the flowmeter during the period p (e.g., emissions from hoses or other flow lines that connect the container to the equipment or cylinder that is being filled).

$FC_i$  = The total number of fill operations over the period p for the valve-hose combination  $C_i$ .

$EF_{Ci}$  = The emission factor for the valve-hose combination  $C_i$ .

$n$  = The number of different valve-hose combinations C used during the period p.

- (h) If the mass of insulating gas j disbursed to customers in new equipment or cylinders over the period p is determined by using the nameplate capacity, or by using the nameplate capacity of the equipment and calculating the partial shipping charge, use the methods in either paragraph (h)(1) or (2) of this section.

- (1) Determine the equipment's actual nameplate capacity, by measuring the nameplate capacities of a representative sample of each make and model and calculating the mean value for each make and model as specified at § 98.454(f).
  - (2) If equipment is shipped with a partial charge, calculate the partial shipping charge by multiplying the nameplate capacity of the equipment by the ratio of the densities of the partial charge to the full charge.
- (i) Estimate the annual emissions of reportable insulating gas  $j$  from the equipment that is installed at an off-site electric power transmission or distribution location before the title to the equipment is transferred by using equation SS-8 to this section:

$$EI = GHG_{i,w} * (M_F + M_C - N_I) \quad \text{Eq. SS-8}$$

Where:

$EI$  = Total annual emissions of reportable insulating gas  $j$  from equipment installation at electric transmission or distribution facilities.

$GHG_{i,w}$  = The weight fraction of fluorinated GHG  $i$  in reportable insulating gas  $j$  if reportable insulating gas  $j$  is a gas mixture, expressed as a decimal fraction. If the GHG  $i$  is not part of a gas mixture, use a value of 1.0.

$M_F$  = The total annual mass of reportable insulating gas  $j$ , in pounds, used to fill equipment during equipment installation at electric transmission or distribution facilities.

$M_C$  = The total annual mass of reportable insulating gas  $j$ , in pounds, used to charge the equipment prior to leaving the electrical equipment manufacturer facility.

$N_I$  = The total annual nameplate capacity of the equipment, in pounds, installed at electric transmission or distribution facilities.

#### § 98.454 Monitoring and QA/QC requirements.

- (a) [Reserved]
- (b) Ensure that all the quantities required by the equations of this subpart have been measured using either flowmeters with an accuracy and precision of  $\pm 1$  percent of full scale or better or scales with an accuracy and precision of  $\pm 1$  percent of the filled weight (gas plus tare) of the containers of each reportable insulating gas that are typically weighed on the scale. For scales that are generally used to weigh cylinders containing 115 pounds of gas when full, this equates to  $\pm 1$  percent of the sum of 115 pounds and approximately 120 pounds tare, or slightly more than  $\pm 2$  pounds. Account for the tare weights of the containers. You may accept gas masses or weights provided by the gas supplier (e.g., for the contents of cylinders containing new gas or for the heels remaining in cylinders returned to the gas supplier) if the supplier provides documentation verifying that accuracy standards are met; however, you remain responsible for the accuracy of these masses and weights under this subpart.
- (c) All flow meters, weigh scales, and combinations of volumetric and density measures that are used to measure or calculate quantities under this subpart must be calibrated using calibration procedures specified by the flowmeter, scale, volumetric or density measure equipment manufacturer. Calibration must be performed prior to the first reporting year. After the initial calibration, recalibration must be performed at the minimum frequency specified by the manufacturer.

- (d) For purposes of equation SS-7 to § 98.453, the emission factor for the valve-hose combination (EFC) must be estimated using measurements and/or engineering assessments or calculations based on chemical engineering principles or physical or chemical laws or properties. Such assessments or calculations may be based on, as applicable, the internal volume of hose or line that is open to the atmosphere during coupling and decoupling activities, the internal pressure of the hose or line, the time the hose or line is open to the atmosphere during coupling and decoupling activities, the frequency with which the hose or line is purged and the flow rate during purges. You must develop a value for EFC (or use an industry-developed value) for each combination of hose and valve fitting, to use in equation SS-7 to § 98.453. The value for EFC must be determined for each combination of hose and valve fitting of a given diameter or size. The calculation must be recalculated annually to account for changes to the specifications of the valves or hoses that may occur throughout the year.
- (e) Electrical equipment manufacturers and refurbishers must account for emissions of each reportable insulating gas that occur as a result of unexpected events or accidental losses, such as a malfunctioning hose or leak in the flow line, during the filling of equipment or containers for disbursement by including these losses in the estimated mass of each reportable insulating gas emitted downstream of the container or flowmeter during the period p.
- (f) If the mass of each reportable insulating gas j disbursed to customers in new equipment over the period p is determined by assuming that it is equal to the equipment's nameplate capacity or, in cases where equipment is shipped with a partial charge, equal to its partial shipping charge, equipment samples for conducting the nameplate capacity tests must be selected using the following stratified sampling strategy in this paragraph (f). For each make and model, group the measurement conditions to reflect predictable variability in the facility's filling practices and conditions (e.g., temperatures at which equipment is filled). Then, independently select equipment samples at random from each make and model under each group of conditions. To account for variability, a certain number of these measurements must be performed to develop a robust and representative average nameplate capacity (or shipping charge) for each make, model, and group of conditions. A Student T distribution calculation should be conducted to determine how many samples are needed for each make, model, and group of conditions as a function of the relative standard deviation of the sample measurements. To determine a sufficiently precise estimate of the nameplate capacity, the number of measurements required must be calculated to achieve a precision of one percent of the true mean, using a 95 percent confidence interval. To estimate the nameplate capacity for a given make and model, you must use the lowest mean value among the different groups of conditions, or provide justification for the use of a different mean value for the group of conditions that represents the typical practices and conditions for that make and model. Measurements can be conducted using SF<sub>6</sub>, another gas, or a liquid. Re-measurement of nameplate capacities should be conducted every five years to reflect cumulative changes in manufacturing methods and conditions over time.
- (g) Ensure the following QA/QC methods are employed throughout the year:
  - (1) Procedures are in place and followed to track and weigh all cylinders or other containers at the beginning and end of the year.
  - (2) [Reserved]
- (h) You must adhere to the following QA/QC methods for reviewing the completeness and accuracy of reporting:
  - (1) Review inputs to equation SS-3 to § 98.453 to ensure inputs and outputs to the company's system are included.

- (2) Do not enter negative inputs and confirm that negative emissions are not calculated. However, the decrease in the inventory for each reportable insulating gas may be calculated as negative.
- (3) Ensure that for each reportable insulating gas, the beginning-of-year inventory matches the end-of-year inventory from the previous year.
- (4) Ensure that for each reportable insulating gas, in addition to the reportable insulating gas purchased from bulk gas distributors, the reportable insulating gas returned from equipment users with or inside equipment and the reportable insulating gas returned from off-site recycling are also accounted for among the total additions.

### § 98.455 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Replace missing data, if needed, based on data from similar manufacturing operations, and from similar equipment testing and decommissioning activities for which data are available.

### § 98.456 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the following information for each chemical at the facility level:

- (a) Pounds of each reportable insulating gas stored in containers at the beginning of the year.
- (b) Pounds of each reportable insulating gas stored in containers at the end of the year.
- (c) Pounds of each reportable insulating gas purchased in bulk.
- (d) Pounds of each reportable insulating gas returned by equipment users with or inside equipment.
- (e) Pounds of each reportable insulating gas returned to site from off site after recycling.
- (f) Pounds of each insulating gas inside new equipment delivered to customers.
- (g) Pounds of each insulating gas delivered to equipment users in containers.
- (h) Pounds of each reportable insulating gas returned to suppliers.
- (i) Pounds of each reportable insulating gas sent off site for destruction.
- (j) Pounds of each reportable insulating gas sent off site to be recycled.
- (k) The nameplate capacity of the equipment, in pounds, delivered to customers with each insulating gas inside, if different from the quantity in paragraph (f) of this section.
- (l) A description of the engineering methods and calculations used to determine emissions from hoses or other flow lines that connect the container to the equipment that is being filled.
- (m) The values for  $EF_{Ci}$  of equation SS-7 to § 98.453 for each hose and valve combination and the associated valve fitting sizes and hose diameters.
- (n) The total number of fill operations for each hose and valve combination, or,  $FC_i$  of equation SS-7 to § 98.453.

- (o) If the mass of each reportable insulating gas disbursed to customers in new equipment over the period p is determined according to the methods required in § 98.453(h), report the mean value of nameplate capacity in pounds for each make, model, and group of conditions.
- (p) If the mass of each reportable insulating gas disbursed to customers in new equipment over the period p is determined according to the methods required in § 98.453(h), report the number of samples and the upper and lower bounds on the 95-percent confidence interval for each make, model, and group of conditions.
- (q) Pounds of each insulating gas used to fill equipment at off-site electric power transmission or distribution locations, or MF, of equation SS-8 to § 98.453.
- (r) Pounds of each insulating gas used to charge the equipment prior to leaving the electrical equipment manufacturer or refurbishment facility, or MC, of equation SS-8 to § 98.453.
- (s) The nameplate capacity of the equipment, in pounds, installed at off-site electric power transmission or distribution locations used to determine emissions from installation, or N<sub>i</sub>, of equation SS-8 to § 98.453.
- (t) For any missing data, you must report the reason the data were missing, the parameters for which the data were missing, the substitute parameters used to estimate emissions in their absence, and the quantity of emissions thereby estimated.
- (u) For each insulating gas reported in paragraphs (a) through (j) and (o) through (r) of this section, an ID number or other appropriate descriptor unique to that insulating gas.
- (v) For each ID number or descriptor reported in paragraph (u) of this section for each unique insulating gas, the name (as required in § 98.3(c)(4)(iii)(G)(1)) and weight percent of each fluorinated gas in the insulating gas.

### § 98.457 Records that must be retained.

In addition to the information required by § 98.3(g), you must retain the following records:

- (a) All information reported and listed in § 98.456.
- (b) Accuracy certifications and calibration records for all scales and monitoring equipment, including the method or manufacturer's specification used for calibration.
- (c) Certifications of the quantity of gas, in pounds, charged into equipment at the electrical equipment manufacturer or refurbishment facility as well as the actual quantity of gas, in pounds, charged into equipment at installation.
- (d) Check-out and weigh-in sheets and procedures for cylinders.
- (e) Residual gas amounts, in pounds, in cylinders sent back to suppliers.
- (f) Invoices for gas purchases and sales.
- (g) GHG Monitoring Plans, as described in § 98.3(g)(5), must be completed by April 1, 2011.

### § 98.458 Definitions.

Except as specified in this section, all terms used in this subpart have the same meaning given in the CAA and subpart A of this part.

*Insulating gas* , for the purposes of this subpart, means any fluorinated GHG or fluorinated GHG mixture, including but not limited to SF<sub>6</sub> and PFCs, that is used as an insulating and/or arc-quenching gas in electrical equipment.

*Reportable insulating gas* , for purposes of this subpart, means an insulating gas whose weighted average GWP, as calculated in equation SS-2 to § 98.452, is greater than one. A fluorinated GHG that makes up either part or all of a reportable insulating gas is considered to be a component of the reportable insulating gas.

## Subpart TT—Industrial Waste Landfills

**Source:** 75 FR 39773, July 12, 2010, unless otherwise noted.

### § 98.460 Definition of the source category.

- (a) This source category applies to industrial waste landfills that accepted waste on or after January 1, 1980, and that are located at a facility whose total landfill design capacity is greater than or equal to 300,000 metric tons.
- (b) *An industrial waste landfill* is a landfill other than a municipal solid waste landfill, a RCRA Subtitle C hazardous waste landfill, or a TSCA hazardous waste landfill, in which industrial solid waste, such as RCRA Subtitle D wastes (non-hazardous industrial solid waste, defined in 40 CFR 257.2), commercial solid wastes, or conditionally exempt small quantity generator wastes, is placed. An industrial waste landfill includes all disposal areas at the facility.
- (c) This source category does not include:
  - (1) Construction and demolition waste landfills.
  - (2) Industrial waste landfills that only receive one or more of the following inert waste materials:
    - (i) Coal combustion or incinerator ash (e.g., fly ash).
    - (ii) Cement kiln dust.
    - (iii) Rocks and/or soil from excavation and construction and similar activities.
    - (iv) Glass.
    - (v) Non-chemically bound sand (e.g., green foundry sand).
    - (vi) Clay, gypsum, or pottery cull.
    - (vii) Bricks, mortar, or cement.
    - (viii) Furnace slag.
    - (ix) Materials used as refractory (e.g., alumina, silicon, fire clay, fire brick).
    - (x) Plastics (e.g., polyethylene, polypropylene, polyethylene terephthalate, polystyrene, polyvinyl chloride).
    - (xi) Other waste material that has a volatile solids concentration of 0.5 weight percent (on a dry basis) or less.



(xiii) Other waste material that has a DOC value of 0.3 weight percent (on a wet basis) or less. DOC value must be determined using a 60-day anaerobic biodegradation test procedure identified in § 98.464(b)(4)(i).

(d) This source category consists of the following sources at industrial waste landfills: Landfills, gas collection systems at landfills, and destruction devices for landfill gases (including flares).

[75 FR 39773, July 12, 2010, as amended at 76 FR 73907, Nov. 29, 2011, 77 FR 51495, Aug. 24, 2012; 78 FR 71979, Nov. 29, 2013]

### § 98.461 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains an industrial waste landfill meeting the criteria in § 98.460 and the facility meets the requirements of § 98.2(a)(2). For the purposes of § 98.2(a)(2), the emissions from the industrial waste landfill are to be determined using the methane generation corrected for oxidation as determined using Equation TT-6 of this subpart times the global warming potential for methane in Table A-1 of subpart A of this part.

### § 98.462 GHGs to report.

- (a) You must report CH<sub>4</sub> generation and CH<sub>4</sub> emissions from industrial waste landfills.
- (b) You must report CH<sub>4</sub> destruction resulting from landfill gas collection and destruction devices, if present.
- (c) You must report under subpart C of this part (General Stationary Fuel Combustion Sources) the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit associated with the landfill gas destruction device, if present, by following the requirements of subpart C of this part.

### § 98.463 Calculating GHG emissions.

(a) For each industrial waste landfill subject to the reporting requirements of this subpart, calculate annual modeled CH<sub>4</sub> generation according to the applicable requirements in paragraphs (a)(1) through (a)(3) of this section. Apply Equation TT-1 of this section for each waste stream disposed of in the landfill and sum the CH<sub>4</sub> generation rates for all waste streams disposed of in the landfill to calculate the total annual modeled CH<sub>4</sub> generation rate for the landfill.

(1) Calculate annual modeled CH<sub>4</sub> generation using Equation TT-1 of this section.

$$G_{CH_4} = \left[ \sum_{x=S}^{T-1} \left\{ W_x \times DOC_x \times MCF \times DOC_F \times F \times \frac{16}{12} \times \left( e^{-k(T-x-1)} - e^{-k(T-x)} \right) \right\} \right] \quad (\text{Eq. TT-1})$$

Where:

$G_{CH_4}$  = Modeled methane generation in reporting year T (metric tons CH<sub>4</sub>).

X = Year in which waste was disposed.

S = Start year of calculation. Use the year 1960 or the opening year of the landfill, whichever is more recent.

T = Reporting year for which emissions are calculated.

$W_X$  = Quantity of waste disposed in the industrial waste landfill in year X from measurement data and/or other company records (metric tons, as received (wet weight)).

$DOC_X$  = Degradable organic carbon for waste disposed in year X from Table TT-1 to this subpart or from measurement data [as specified in paragraph (a)(3) of this section], if available [fraction (metric tons C/metric ton waste)].

$DOC_F$  = Fraction of DOC dissimilated (fraction); use the default value of 0.5. If measured values of DOC are available using the 60-day anaerobic biodegradation test procedure identified in § 98.464(b)(4)(i), use a default value of 1.0.

MCF = Methane correction factor (fraction). Use the default value of 1 unless there is active aeration of waste within the landfill during the reporting year. If there is active aeration of waste within the landfill during the reporting year, use either the default value of 1 or select an alternative value no less than 0.5 based on site-specific aeration parameters.

F = Fraction by volume of  $CH_4$  in landfill gas (fraction, dry basis, corrected to 0% oxygen). If you have a gas collection system, use the annual average  $CH_4$  concentration from measurement data for the current reporting year; otherwise, use the default value of 0.5.

k = Decay rate constant from Table TT-1 to this subpart (yr<sup>-1</sup>). Select the most applicable k value for the majority of the past 10 years (or operating life, whichever is shorter).

- (2) **Waste stream quantities.** Determine annual waste quantities as specified in paragraphs (a)(2)(i) through (ii) of this section for each year starting with January 1, 1960 or the year the landfills first accepted waste if after January 1, 1960, up until the most recent reporting year. The choice of method for determining waste quantities will vary according to the availability of historical data. Beginning in the first emissions reporting year (2011 or later) and for each year thereafter, use the procedures in paragraph (a)(2)(i) of this section to determine waste stream quantities. These procedures should also be used for any year prior to the first emissions reporting year for which the data are available. For other historical years, use paragraph (a)(2)(i) of this section, where waste disposal records are available, and use the procedures outlined in paragraph (a)(2)(ii) of this section when waste disposal records are unavailable, to determine waste stream quantities. Historical disposal quantities deposited (*i.e.*, prior to the first year in which monitoring begins) should only be determined once, as part of the first annual report, and the same values should be used for all subsequent annual reports, supplemented by the next year's data on new waste disposal.
- (i) Determine the quantity of waste (in metric tons as received, *i.e.*, wet weight) disposed of in the landfill separately for each waste stream by any one or a combination of the following methods.
- (A) Direct mass measurements.
  - (B) Direct volume measurements multiplied by waste stream density determined from periodic density measurement data or process knowledge.
  - (C) Mass balance procedures, determining the mass of waste as the difference between the mass of the process inputs and the mass of the process outputs.

(D) The number of loads (e.g., trucks) multiplied by the mass of waste per load based on the working capacity of the container or vehicle.

(ii) Determine the historical disposal quantities for landfills using the Waste Disposal Factor approach in paragraphs (a)(2)(ii)(A) and (B) of this section when historical production or processing data are available. If production or processing data are available for a given year, you must use Equation TT-3 of this section for that year. Determine historical disposal quantities using the method specified in paragraph (a)(2)(ii)(C) of this section when historical production or processing data are not available, and for waste streams received from an off-site facility when historical disposal quantities cannot be determined using the methods specified in paragraph (a)(2)(i) of this section.

(A) **Determining Waste Disposal Factor:** For each waste stream disposed of in the landfill, calculate the average waste disposal rate per unit of production or unit throughput using all available waste quantity data and corresponding production or processing rates for the process generating that waste or, if appropriate, the facility, using Equation TT-2 of this section.

$$WDF = \left[ \sum_{i=Y_1}^{Y_2} \left\{ \frac{W_i}{N \times P_i} \right\} \right] \quad (\text{Eq. TT-2})$$

Where:

WDF = Average waste disposal factor as determined for the first annual report required for this industrial waste landfill (metric tons per production unit).

X = Year in which waste was disposed. Include only those years for which disposal and production data are both available; the years do not need to be sequential.

Y<sub>1</sub> = First year in which disposal and production/throughput data are both available.

Y<sub>2</sub> = First year for which GHG emissions from this industrial waste landfill must be reported.

N = Number of years for which disposal and production/throughput data are both available.

W<sub>x</sub> = Quantity of waste placed in the industrial waste landfill in year X from measurement data and/or other company records (metric tons, as received (wet weight)).

P<sub>x</sub> = Quantity of product produced or feedstock entering the process or facility in year X from measurement data and/or other company records (production units). You must use the same basis for all years in the calculation. That is, P<sub>x</sub> must be determined based on production (quantity of product produced) for all "N" years or P<sub>x</sub> must be determined based on throughput (quantity of feedstock) for all "N" years.

(B) **Calculate waste:** For each waste stream disposed of in the landfill, calculate the waste disposal quantities for historic years in which direct waste disposal measurements are not available using historical production data and Equation TT-3 of this section.

$$W_x = WDF \times P_x \quad (\text{Eq. TT-3})$$

Where:

X = Historic year in which waste was disposed.

$W_x$  = Calculated quantity of waste placed in the landfill in year X (metric tons).

WDF = Average waste disposal factor from Equation TT-2 of this section (metric tons per production unit).

$P_x$  = Quantity of product produced or feedstock entering the process or facility in year X from measurement data and/or other company records (production units). You must use the same basis for  $P_x$  (either production only or throughput only) as used to determine WDF in Equation TT-2 of this section.

- (C) For any year in which historic production or processing data are not available such that historic waste quantities cannot be estimated using Equation TT-3 of this section, calculate an average annual bulk waste disposal quantity using either Equation TT-4a of this section when data are available consecutively for the most recent disposal years or Equation TT-4b of this section when data are available for sporadic (non-consecutive) years.

$$W_x = \frac{LFC}{(YrData - YrOpen + 1)} \quad (\text{Eq. TT-4a})$$

Where:

$W_x$  = Quantity of waste placed in the landfill in year X (metric tons, wet basis). This annual bulk waste disposal quantity applies for all years from "YrOpen" to "YrData" inclusive.

LFC = Capacity of the landfill used (or the total quantity of waste-in-place) at the end of the "YrData" from design drawings or engineering estimates (metric tons). For closed landfills for which waste quantity data are not available, use the landfill's design capacity.

YrData = The year prior to the year when waste disposal data are first available for all subsequent years from company records or from Equation TT-3 of this section. For landfills for which waste quantity data are not available, the year in which the landfill last received waste.

YrOpen = Year 1960 or the year in which the landfill first received waste from company records, whichever is more recent. If no data are available for estimating YrOpen for a closed landfill, use 1960 as the default "YrOpen" for the landfill.

$$W_x = \frac{WIP - \sum_{n=1}^{NYrData} W_{meas,n}}{(YrLast - YrOpen + 1 - NYrData)} \quad (\text{Eq. TT-4b})$$

Where:

$W_X$  = Quantity of waste placed in the landfill in year X (metric tons, wet basis). This annual bulk waste disposal quantity applies for all years for which waste quantity data are not available from company records or from Equation TT-3 of this section.

WIP = Quantity of waste in-place at the start of the reporting year from design drawings or engineering estimates (metric tons). For closed landfills for which waste in-place quantities are not available, use the landfill's design capacity.

$W_{\text{meas},n}$  = Annual quantity of waste placed in the landfill for the nth measurement year from company records or from Equation TT-3 of this section.

YrLast = The last year, prior to the reporting year, that the landfill received waste.

YrOpen = Year 1960 or the year in which the landfill first received waste from company records, whichever is more recent. If no data are available for estimating YrOpen for a closed landfill, use 1960 as the default "YrOpen" for the landfill.

NYrData = The number of years for which annual waste disposal quantities are available from company records or from Equation TT-3 of this section from YrOpen to YrLast inclusive.

(3) **Degradable organic content (DOC).** For any year, X, in Equation TT-1 of this section, use either the applicable default DOC values provided in Table TT-1 of this subpart or determine values for  $\text{DOC}_X$  as specified in paragraphs (a)(3)(i) through (iv) of this section. When developing historical waste quantity data, you may use default DOC values from Table TT-1 of this subpart for certain years and determined values for  $\text{DOC}_X$  for other years. The historical values for DOC or  $\text{DOC}_X$  must be developed only for the first annual report required for the industrial waste landfill; and used for all subsequent annual reports (e.g., if DOC for year x = 1990 was determined to be 0.15 in the first reporting year, you must use 0.15 for the 1990 DOC value for all subsequent annual reports).

- (i) For the first year in which GHG emissions from this industrial waste landfill must be reported, determine the  $\text{DOC}_X$  value of each waste stream disposed of in the landfill no less frequently than once per quarter using the methods specified in § 98.464(b). Calculate annual  $\text{DOC}_X$  for each waste stream as the arithmetic average of all  $\text{DOC}_X$  values for that waste stream that were measured during the year.
- (ii) For subsequent years (after the first year in which GHG emissions from this industrial waste landfill must be reported), either use the  $\text{DOC}_X$  of each waste stream calculated for the most recent reporting year for which DOC values were determined according to paragraph (a)(3)(i) of this section, or determine new DOC values for that year following the requirements in paragraph (a)(3)(i) of this section. You must determine new DOC values following the requirements in paragraph (a)(3)(i) of this section if changes in the process operations occurred during the previous reporting year that can reasonably be expected to alter the characteristics of the waste stream, such as the water content or volatile solids concentration. Should changes to the waste stream occur, you must revise the GHG Monitoring Plan as required in § 98.3(g)(5)(iii) and report the new  $\text{DOC}_X$  value according to the requirements of § 98.466.

- (iii) If  $DOC_x$  measurement data for each waste stream are available according to the methods specified in § 98.464(b) for years prior to the first year in which GHG emissions from this industrial waste landfill must be reported, determine  $DOC_x$  for each waste stream as the arithmetic average of all  $DOC_x$  values for that waste stream that were measured in Year X. A single measurement value is acceptable for determining  $DOC_x$  for years prior to the first reporting year.
- (iv) For historical years for which  $DOC_x$  measurement data, determined according to the methods specified in § 98.464(b), are not available, determine the historical values for  $DOC_x$  using the applicable methods specified in paragraphs (a)(3)(iv)(A) and (B) of this section. Determine these historical values for  $DOC_x$  only for the first annual report required for this industrial waste landfill; historical values for  $DOC_x$  calculated for this first annual report should be used for all subsequent annual reports.
  - (A) For years in which waste stream-specific disposal quantities are determined (as required in paragraphs (a)(2) (ii)(A) and (B) of this section), calculate the average DOC value for a given waste stream as the arithmetic average of all DOC measurements of that waste stream that follow the methods provided in § 98.464(b), including any measurement values for years prior to the first reporting year and the four measurement values required in the first reporting year. Use the resulting waste-specific average DOC value for all applicable years (i.e., years in which waste stream-specific disposal quantities are determined) for which direct DOC measurement data are not available.
  - (B) For years for which bulk waste disposal quantities are determined according to paragraphs (a)(2)(ii)(C) of this section, calculate the weighted average bulk DOC value according to the following: Calculate the average DOC value for each waste stream as the arithmetic average of all DOC measurements of that waste stream that follows the methods provided in § 98.464(b) (generally, this will include only the DOC values determined in the first year in which GHG emissions from this industrial waste landfill must be reported); calculate the average annual disposal quantity for each waste stream as the arithmetic average of the annual disposal quantities for each year in which waste stream-specific disposal quantities have been determined; and calculate the bulk waste DOC value using Equation TT-5 of this section. Use the bulk waste DOC value as  $DOC_x$  for all years for which bulk waste disposal quantities are determined according to paragraphs (a)(2)(ii)(C) of this section.

$$DOC_{bulk} = \frac{\sum_{d=1}^N (DOC_{avg,d} \times Y_{avg,d})}{\sum_{d=1}^N Y_{avg,d}} \quad (\text{Eq. TT-5})$$

Where:

$DOC_{bulk}$  = Degradable organic content value for bulk historical waste placed in the landfill (mass fraction).

N = Number of different waste streams placed in the landfill.

$n$  = Index for waste stream.

$DOC_{ave,n}$  = Average degradable organic content value for waste stream “ $n$ ” based on available measurement data (mass fraction).

$W_{ave,n}$  = Average annual quantity of waste stream “ $n$ ” placed in the landfill for years in which waste stream-specific disposal quantities have been determined (metric tons per year, wet basis).

(b) For each landfill, calculate  $CH_4$  generation (adjusted for oxidation in cover materials) and  $CH_4$  emissions (taking into account any  $CH_4$  recovery, if applicable, and oxidation in cover materials) according to the applicable methods in paragraphs (b)(1) through (b)(3) of this section.

(1) For each landfill, calculate  $CH_4$  generation, adjusted for oxidation, from the modeled  $CH_4$  ( $G_{CH_4}$  from Equation TT-1 of this section) using Equation TT-6 of this section.

$$MG = G_{CH_4} \times (1 - OX) \quad (\text{Eq. TT-6})$$

Where:

MG = Methane generation, adjusted for oxidation, from the landfill in the reporting year (metric tons  $CH_4$ ).

$G_{CH_4}$  = Modeled methane generation rate in reporting year from Equation TT-1 of this section (metric tons  $CH_4$ ).

OX = Oxidation fraction from Table HH-4 of subpart HH of this part.

(2) For landfills that do not have landfill gas collection systems operating during the reporting year, the  $CH_4$  emissions are equal to the  $CH_4$  generation (MG) calculated in Equation TT-6 of this section.

(3) For landfills with landfill gas collection systems in operation during any portion of the reporting year, perform all of the calculations specified in paragraphs (b)(3)(i) through (iv) of this section.

(i) Calculate the quantity of  $CH_4$  recovered according to the requirements at § 98.343(b).

(ii) Calculate  $CH_4$  emissions using the Equation HH-6 of § 98.343(c)(3)(i), except use  $G_{CH_4}$  determined using Equation TT-1 of this section in Equation HH-6 of § 98.343(c)(3)(i).

(iii) Calculate  $CH_4$  generation (MG) from the quantity of  $CH_4$  recovered using Equation HH-7 of § 98.343(c)(3)(ii).

(iv) Calculate  $CH_4$  emissions from the quantity of  $CH_4$  recovered using Equation HH-8 of § 98.343(c)(3)(ii).

[75 FR 39773, July 12, 2010, as amended at 76 FR 73907, Nov. 29, 2011; 78 FR 71979, Nov. 29, 2013]

## § 98.464 Monitoring and QA/QC requirements.

(a) For calendar year 2011 monitoring, the facility may submit a request to the Administrator to use one or more best available monitoring methods as listed in § 98.3(d)(1)(i) through (iv). The request must be submitted no later than October 12, 2010 and must contain the information in § 98.3(d)(2)(ii). To obtain



approval, the request must demonstrate to the Administrator's satisfaction that it is not reasonably feasible to acquire, install, and operate a required piece of monitoring equipment by January 1, 2011. The use of best available monitoring methods will not be approved beyond December 31, 2011.

- (b) For each waste stream placed in the landfill during the reporting year for which you choose to determine volatile solids concentration and/or a waste stream-specific  $\text{DOC}_x$ , you must collect and test a representative sample of that waste stream using the methods specified in paragraphs (b)(1) through (b)(4) of this section, as applicable.
  - (1) Develop and follow a sampling plan to collect a representative sample (in terms of composition and moisture content) of each waste stream placed in the landfill for which testing is elected.
  - (2) Determine the percent total solids and the percent volatile solids of each sample following Standard Method 2540G "Total, Fixed, and Volatile Solids in Solid and Semisolid Samples" (incorporated by reference; see § 98.7).
  - (3) For the purposes of § 98.460(c)(2)(xii), the volatile solids concentration (weight percent on a dry basis) is the percent volatile solids determined using Standard Method 2540G "Total, Fixed, and Volatile Solids in Solid and Semisolid Samples" (incorporated by reference; see § 98.7).
  - (4) Determine DOC value of a waste stream by either using at least a 60-day anaerobic biodegradation test as specified in paragraph (b)(4)(i) of this section or by estimating the DOC value based on the total and volatile solids measurements as specified in paragraph (b)(4)(ii) of this section.
    - (i) Perform an anaerobic biodegradation test and determine the DOC value of a waste stream following the procedures and requirements in paragraphs (b)(4)(i)(A) through (E) of this section.
      - (A) You may use the procedures published by a consensus-based standards organization to conduct a minimum of a 60-day anaerobic biodegradation test. Consensus-based standards organizations include, but are not limited to, the following: ASTM International (100 Barr Harbor Drive, P.O. Box CB700, West Conshohocken, Pennsylvania 19428-B2959, (800) 262-1373, <http://www.astm.org>), the American National Standards Institute (ANSI, 1819 L Street, NW., 6th floor, Washington, DC 20036, (202) 293-8020, <http://www.ansi.org>), the American Society of Mechanical Engineers (ASME, Three Park Avenue, New York, NY 10016-5990, (800) 843-2763, <http://www.asme.org>), and the North American Energy Standards Board (NAESB, 801 Travis Street, Suite 1675, Houston, TX 77002, (713) 356-0060, <http://www.api.org>).
      - (B) Use a minimum of four samples: Two waste stream samples, a control sample using a known substrate (such as ethanol), and a digester sludge blank sample. Each waste stream sample must be appropriately ground to ensure the waste material is fully exposed to the anaerobic digester sludge.
      - (C) Determine the net mass of carbon degraded in the control sample as the difference in the results of the control sample and the digester sludge blank sample. Determine the net mass of carbon degraded in each waste stream sample as the difference in the results of each waste stream sample and the digester sludge blank sample.



- (D) Determine the fraction of carbon degraded in the control sample as the net mass of carbon degraded in the control sample divided by the mass of carbon added via the substrate material in the control sample. If less than 50 percent of the theoretical mass of carbon in the control sample is degraded, the test run is invalid.
- (E) Determine the DOC of each waste sample using Equation TT-7 of this section. If the DOC values for the two waste stream samples differ by more than 20 percent, the test run is invalid. The DOC of the waste stream is determined as the average DOC value of the two waste stream samples determined during a valid test.

$$DOC_x = \frac{MCD_{sample,x}}{M_{sample,x}} \quad (\text{Eq. TT-7})$$

Where:

$DOC_x$  = Degradable organic content of the waste stream in Year X (weight fraction, wet basis)

$MCD_{sample,x}$  = Mass of carbon degraded in the waste stream sample in Year X as determined in paragraph (b)(4)(i)(C) of this section [milligrams (mg)].

$M_{sample,x}$  = Mass of waste stream sample used in the anaerobic degradation test in Year X (mg, wet basis).

- (ii) Calculate the waste stream-specific  $DOC_x$  value using Equation TT-8 of this section.

$$DOC_x = F_{DOC} \times \frac{\% \text{ Volatile Solids}_x}{100\%} \times \frac{\% \text{ Total Solids}_x}{100\%} \quad (\text{Eq. TT-8})$$

Where:

$DOC_x$  = Degradable organic content of waste stream in Year X (weight fraction, wet basis)

$F_{DOC}$  = Fraction of the volatile residue that is degradable organic carbon (weight fraction). Use a default value of 0.6.

$\% \text{ Volatile Solids}_x$  = Percent volatile solids determined using Standard Method 2540G Total, "Fixed, and Volatile Solids in Solid and Semisolid Samples" (incorporated by reference; see § 98.7) for Year X [milligrams (mg) volatile solids per 100 mg dried solids].

$\% \text{ Total Solids}_x$  = Percent total solids determined using Standard Method 2540G "Total, Fixed, and Volatile Solids in Solid and Semisolid Samples" (incorporated by reference; see § 98.7) for Year X (mg dried solids per 100 mg wet waste).

- (c) For each waste stream that was historically managed in the landfill for which you choose to determine volatile solids concentration and/or a waste stream-specific  $DOC_x$ , you must determine volatile solids concentration or  $DOC_x$  of the waste stream as initially placed in the landfill using the methods specified in paragraph (c)(1) or (2) of this section, as applicable.

- (1) If you can identify a similar waste stream to the waste stream that was historically managed in the landfill, you must determine the volatile solids concentration or  $\text{DOC}_x$  of the similar waste stream using the applicable procedures in paragraphs (b)(1) through (4) of this section.
  - (2) If you cannot identify a similar waste stream to the waste stream that was historically managed in the landfill, you may determine the volatile solids concentration or  $\text{DOC}_x$  of the historically managed waste stream using process knowledge. You must document the basis for the volatile solids concentration or  $\text{DOC}_x$  value as determined through process knowledge.
- (d) For landfills with gas collection systems, operate, maintain, and calibrate a gas composition monitor capable of measuring the concentration of  $\text{CH}_4$  according to the requirements specified at § 98.344(b).
  - (e) For landfills with gas collection systems, install, operate, maintain, and calibrate a gas flow meter capable of measuring the volumetric flow rate of the recovered landfill gas according to the requirements specified at § 98.344(c).
  - (f) For landfills with gas collection systems, all temperature, pressure, and if applicable, moisture content monitors must be calibrated using the procedures and frequencies specified by the manufacturer.
  - (g) For landfills electing to measure the fraction by volume of  $\text{CH}_4$  in landfill gas (F), follow the requirements in paragraphs (g)(1) and (g)(2) of this section.
    - (1) Use a gas composition monitor capable of measuring the concentration of  $\text{CH}_4$  on a dry basis that is properly operated, calibrated, and maintained according to the requirements specified at § 98.344(b). You must either use a gas composition monitor that is also capable of measuring the  $\text{O}_2$  concentration correcting for excess (infiltration) air or you must operate, maintain, and calibrate a second monitor capable of measuring the  $\text{O}_2$  concentration on a dry basis according to the manufacturer's specifications.
    - (2) Use Equation TT-9 of this section to correct the measured  $\text{CH}_4$  concentration to 0% oxygen. If multiple  $\text{CH}_4$  concentration measurements are made during the reporting year, determine F separately for each measurement made during the reporting year, and use the results to determine the arithmetic average value of F for use in Equation TT-1 of this part.

$$F = \left( \frac{C_{\text{CH}_4}}{100\%} \right) \times \left[ \frac{20.9_c}{(20.9 - \%O_2)} \right] \quad (\text{Eq. TT-9})$$

Where:

F = Fraction by volume of  $\text{CH}_4$  in landfill gas (fraction, dry basis, corrected to 0% oxygen).

$C_{\text{CH}_4}$  = Measured  $\text{CH}_4$  concentration in landfill gas (volume %, dry basis).

$20.9_c$  = Defined  $\text{O}_2$  correction basis, (volume %, dry basis).

$20.9$  =  $\text{O}_2$  concentration in air (volume %, dry basis).

$\%O_2$  = Measured  $\text{O}_2$  concentration in landfill gas (volume %, dry basis).

- (h) The facility shall document the procedures used to ensure the accuracy of the estimates of disposal quantities and, if the industrial waste landfill has a gas collection system, gas flow rate, gas composition, temperature, pressure, and moisture content measurements. These procedures include, but are not limited to, calibration of weighing equipment, fuel flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices shall also be recorded, and the technical basis for these estimates shall be provided.

[75 FR 39773, July 12, 2010, as amended at 76 FR 73908, Nov. 29, 2011; 77 FR 51495, Aug. 24, 2012; 78 FR 71979, Nov. 29, 2013]

#### **§ 98.465 Procedures for estimating missing data.**

- (a) A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a meter malfunctions during unit operation or if a required fuel sample is not taken), a substitute data value for the missing parameter shall be used in the calculations, in accordance with paragraph (b) of this section.
- (b) For industrial waste landfills with gas collection systems, follow the procedures for estimating missing data specified in § 98.345(a) and (b).

#### **§ 98.466 Data reporting requirements.**

In addition to the information required by § 98.3(c), each annual report must contain the following information for each landfill.

- (a) Report the following general landfill information:
  - (1) A classification of the landfill as “open” (actively received waste in the reporting year) or “closed” (no longer receiving waste).
  - (2) The year in which the landfill first started accepting waste for disposal.
  - (3) The last year the landfill accepted waste (for open landfills, enter the estimated year of landfill closure).
  - (4) The capacity (in metric tons) of the landfill.
  - (5) An indication of whether leachate recirculation is used during the reporting year and its typical frequency of use over the past 10 years (e.g., used several times a year for the past 10 years, used at least once a year for the past 10 years, used occasionally but not every year over the past 10 years, not used).
- (b) Report the following waste characterization and modeling information:
  - (1) The number of waste streams (including “Other Industrial Solid Waste (not otherwise listed)” and “Inerts”) for which Equation TT-1 of this subpart is used to calculate modeled CH<sub>4</sub> generation.
  - (2) A description of each waste stream (including the types of materials in each waste stream) for which Equation TT-1 of this subpart is used to calculate modeled CH<sub>4</sub> generation.
  - (3) The fraction of CH<sub>4</sub> in the landfill gas, F, (volume fraction, dry basis, corrected to 0% oxygen) for the reporting year and an indication as to whether this was the default value or a value determined through measurement data.

- (4) The methane correction factor (MCF) value used in the calculations. If an MCF value other than the default of 1 is used, provide a description of the aeration system, including aeration blower capacity, the fraction of the landfill containing waste affected by the aeration, the total number of hours during the year the aeration blower was operated, and other factors used as a basis for the selected MCF value.
- (5) For each waste stream, the decay rate (k) value used in the calculations.
- (c) Report the following historical waste information:
  - (1) [Reserved]
  - (2) For each waste stream identified in paragraph (b) of this section, the method(s) for estimating historical waste disposal quantities and the range of years for which each method applies.
  - (3) For each waste stream identified in paragraph (b) of this section for which Equation TT-2 of this subpart is used, provide:
    - (i) [Reserved]
    - (ii) The year of the data used in Equation TT-2 of § 98.463 for the waste disposal quantity and production quantity, for each year used in Equation TT-2 to calculate the average waste disposal factor (WDF).
    - (iii) [Reserved]
  - (4) If Equation TT-4a of this subpart is used, provide:
    - (i) The value of landfill capacity (LFC).
    - (ii) YrData.
    - (iii) YrOpen.
  - (5) If Equation TT-4b of this subpart is used, provide:
    - (i) WIP (i.e., the quantity of waste in-place at the start of the reporting year from design drawings or engineering estimates (metric tons) or, for closed landfills for which waste in-place quantities are not available, the landfill's design capacity).
    - (ii) The cumulative quantity of waste placed in the landfill for the years for which disposal quantities are available from company record or from Equation TT-3 of this part.
    - (iii) YrLast.
    - (iv) YrOpen.
    - (v) NYrData.
- (d) For each year of landfilling starting with the "Start Year" (S) and each year thereafter up to the current reporting year, report the following information:
  - (1) The calendar year for which the following data elements apply.
  - (2) The quantity of waste ( $W_x$ ) disposed of in the landfill (metric tons, wet weight) for the specified year for each waste stream identified in paragraph (b) of this section.

- (3) For each waste stream, the degradable organic carbon (DOC<sub>x</sub>) value (mass fraction) for the specified year and an indication as to whether this was the default value from Table TT-1 to this subpart, a measured value using a 60-day anaerobic biodegradation test as specified in § 98.464(b)(4)(i), or a value based on total and volatile solids measurements as specified in § 98.464(b)(4)(ii). If DOC<sub>x</sub> was determined by a 60-day anaerobic biodegradation test, specify the test method used.
- (e) Report the following information describing the landfill cover material:
  - (1) The type of cover material used (as either organic cover, clay cover, sand cover, or other soil mixtures).
  - (2) For each type of cover material used, the surface area (in square meters) at the start of the reporting year for the landfill sections that contain waste and that are associated with the selected cover type.
- (f) The modeled annual methane generation (G<sub>CH<sub>4</sub></sub>) for the reporting year (metric tons CH<sub>4</sub>) calculated using Equation TT-1 of this subpart.
- (g) For landfills without gas collection systems, provide:
  - (1) The annual methane emissions (i.e., the methane generation (MG), adjusted for oxidation, calculated using Equation TT-6 of this subpart), reported in metric tons CH<sub>4</sub>.
  - (2) An indication of whether passive vents and/or passive flares (vents or flares that are not considered part of the gas collection system as defined in § 98.6) are present at this landfill.
- (h) For landfills with gas collection systems, in addition to the reporting requirements in paragraphs (a) through (f) of this section, provide:
  - (1) The annual methane generation, adjusted for oxidation, calculated using Equation TT-6 of this subpart, reported in metric tons CH<sub>4</sub>.
  - (2) The oxidation factor used in Equation TT-6 of this subpart.
  - (3) All information required under 40 CFR 98.346(i)(1) through (7) and 40 CFR 98.346(i)(9) through (12).

[75 FR 39773, July 12, 2010, as amended at 76 FR 73909, Nov. 29, 2011; 78 FR 71980, Nov. 29, 2013; 79 FR 63799, Oct. 24, 2014]

## § 98.467 Records that must be retained.

- (a) The calibration records for all monitoring equipment, including the method or manufacturer's specification used for calibration, and all measurement data used for the purposes of § 98.460(c)(2)(xii) or (xiii) or used to determine waste stream-specific DOC<sub>x</sub> values for use in Equation TT-1 of § 98.463.
- (b) **Verification software records.** You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (b)(1) and (2) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (b)(1) and (2) of this section.
  - (1) Quantity of each product produced or feedstock entering the process or facility per waste stream per year, from measurement data and/or other company records. You must use the same basis for all years in the calculation (i.e., based on production or based on quantity of feedstock) (metric tons) (Equation TT-2 of § 98.463).
  - (2) [Reserved]

[79 FR 63799, Oct. 24, 2014]

## § 98.468 Definitions.

Except as provided below, all terms used in this subpart have the same meaning given in the CAA and subpart A of this part.

**Construction and demolition (C&D) waste landfill** means a solid waste disposal facility subject to the requirements of subparts A or B of part 257 of this chapter that receives construction and demolition waste and does not receive hazardous waste (defined in § 261.3 of this chapter) or industrial solid waste (defined in § 258.2 of this chapter) or municipal solid waste (defined in § 98.6 of this part) other than residential lead-based paint waste. A C&D waste landfill typically receives any one or more of the following types of solid wastes: roadwork material, excavated material, demolition waste, construction/renovation waste, and site clearance waste.

**Design capacity** means the maximum amount of solid waste a landfill can accept. For the purposes of this subpart, for landfills that have a permit, the *design capacity* can be determined in terms of volume or mass in the most recent permit issued by the state, local, or Tribal agency responsible for regulating the landfill, plus any in-place waste not accounted for in the most recent permit. If the owner or operator chooses to convert the design capacity from volume to mass to determine its design capacity, the calculation must include a site-specific density. If the design capacity is within 10 percent of the applicability threshold in § 98.460(a) and there is a change in the production process that can reasonably be expected to change the site-specific waste density, the site-specific waste density must be redetermined and the design capacity must be recalculated based on the new waste density.

**Industrial sludge** means the residual, semi-solid material left from industrial wastewater treatment processes or wet air pollution control devices (e.g., wet scrubbers). *Industrial sludge* includes underflow material collected in primary or secondary clarifiers, settling basins, or precipitation tanks as well as dredged materials from wastewater tanks or impoundments. *Industrial sludge* also includes the semi-solid materials remaining after these materials are dewatered via a belt process, centrifuge, or similar dewatering process.

**Solid waste** has the meaning established by the Administrator pursuant to the Solid Waste Disposal Act (42 U.S.C.A. 6901 et seq.).

**Waste stream** means industrial solid waste material that is generated by a specific manufacturing process or client. For wastes generated at the facility that includes the industrial waste landfill, a waste stream is the industrial solid waste material generated by a specific processing unit at that facility. For industrial solid wastes that are received from off-site facilities, a waste stream can be defined as each waste shipment or group of waste shipments received from a single client or group of clients that produce industrial solid wastes with similar waste properties.

[75 FR 39773, July 12, 2010, as amended at 76 FR 73910, Nov. 29, 2011; 78 FR 71980, Nov. 29, 2013]

**Table TT-1 to Subpart TT of Part 98—Default DOC and Decay Rate Values for Industrial Waste Landfills**

| Industry/Waste Type                                                                    | DOC<br>(weight<br>fraction, wet<br>basis) | k<br>[dry<br>climate <sup>a</sup> ]<br>(yr <sup>-1</sup> ) | k<br>[moderate<br>climate <sup>a</sup> ]<br>(yr <sup>-1</sup> ) | k<br>[wet<br>climate <sup>a</sup> ]<br>(yr <sup>-1</sup> ) |
|----------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------|
| Food Processing (other than industrial sludge)                                         | 0.22                                      | 0.06                                                       | 0.12                                                            | 0.18                                                       |
| Pulp and Paper Industry:<br>Pulp and paper wastes segregated into<br>separate streams: |                                           |                                                            |                                                                 |                                                            |
| Boiler Ash                                                                             | 0.06                                      | 0.02                                                       | 0.03                                                            | 0.04                                                       |
| Wastewater Sludge                                                                      | 0.12                                      | 0.02                                                       | 0.04                                                            | 0.06                                                       |
| Kraft Recovery Wastes <sup>b</sup>                                                     | 0.025                                     | 0.02                                                       | 0.03                                                            | 0.04                                                       |
| Other Pulp and Paper Wastes (not otherwise<br>listed)                                  | 0.20                                      | 0.02                                                       | 0.03                                                            | 0.04                                                       |
| Pulp and paper wastes not segregated into<br>separate streams:                         |                                           |                                                            |                                                                 |                                                            |
| Pulp and paper manufacturing wastes, general<br>(other than industrial sludge)         | 0.15                                      | 0.02                                                       | 0.03                                                            | 0.04                                                       |
| Wood and Wood Product (other than<br>industrial sludge)                                | 0.43                                      | 0.02                                                       | 0.03                                                            | 0.04                                                       |
| Construction and Demolition                                                            | 0.08                                      | 0.02                                                       | 0.03                                                            | 0.04                                                       |
| Industrial Sludge <sup>c</sup>                                                         | 0.09                                      | 0.02                                                       | 0.04                                                            | 0.06                                                       |
| Inert Waste [i.e., wastes listed in §<br>98.460(c)(2)]                                 | 0                                         | 0                                                          | 0                                                               | 0                                                          |
| Other Industrial Solid Waste (not otherwise                                            | 0.20                                      | 0.02                                                       | 0.04                                                            | 0.06                                                       |

<sup>a</sup> The applicable climate classification is determined based on the annual rainfall plus the recirculated leachate application rate. Recirculated leachate application rate (in inches/year) is the total volume of leachate recirculated from company records or engineering estimates and applied to the landfill divided by the area of the portion of the landfill containing waste [with appropriate unit conversions].

Dry climate = precipitation plus recirculated leachate less than 20 inches/year;

Moderate climate = precipitation plus recirculated leachate from 20 to 40 inches/year (inclusive);

Wet climate = precipitation plus recirculated leachate greater than 40 inches/year.

Alternatively, landfills that use leachate recirculation can elect to use the k value for wet climate rather than calculating the recirculated leachate rate.

<sup>b</sup> Kraft Recovery Wastes include green liquor dregs, slaker grits, and lime mud, which may also be referred to collectively as causticizing or recausticizing wastes.

<sup>c</sup> A facility that can segregate out pulp and paper industry wastewater sludge must apply the 0.12 DOC value to that portion of the sludge.

| Industry/Waste Type | DOC<br>(weight<br>fraction, wet<br>basis) | k<br>[dry<br>climate <sup>a</sup> ]<br>(yr <sup>-1</sup> ) | k<br>[moderate<br>climate <sup>a</sup> ]<br>(yr <sup>-1</sup> ) | k<br>[wet<br>climate <sup>a</sup> ]<br>(yr <sup>-1</sup> ) |
|---------------------|-------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------|
| listed)             |                                           |                                                            |                                                                 |                                                            |

<sup>a</sup> The applicable climate classification is determined based on the annual rainfall plus the recirculated leachate application rate. Recirculated leachate application rate (in inches/year) is the total volume of leachate recirculated from company records or engineering estimates and applied to the landfill divided by the area of the portion of the landfill containing waste [with appropriate unit conversions].

Dry climate = precipitation plus recirculated leachate less than 20 inches/year;

Moderate climate = precipitation plus recirculated leachate from 20 to 40 inches/year (inclusive);

Wet climate = precipitation plus recirculated leachate greater than 40 inches/year.

Alternatively, landfills that use leachate recirculation can elect to use the k value for wet climate rather than calculating the recirculated leachate rate.

<sup>b</sup> Kraft Recovery Wastes include green liquor dregs, slaker grits, and lime mud, which may also be referred to collectively as causticizing or recausticizing wastes.

<sup>c</sup> A facility that can segregate out pulp and paper industry wastewater sludge must apply the 0.12 DOC value to that portion of the sludge.

[75 FR 39773, July 12, 2010, as amended at 76 FR 73910, Nov. 29, 2011; 78 FR 71981, Nov. 29, 2013; 81 FR 89274, Dec. 9, 2016]

## Subpart UU—Injection of Carbon Dioxide

**Source:** 75 FR 75086, Dec. 1, 2010, unless otherwise noted.

### § 98.470 Definition of the source category.

- (a) The injection of carbon dioxide (CO<sub>2</sub>) source category comprises any well or group of wells that inject a CO<sub>2</sub> stream into the subsurface.
- (b) If you report under subpart RR of this part for a well or group of wells, you shall not report under this subpart for that well or group of wells.
- (c) If you report under subpart VV of this part for a well or group of wells, you shall not report under this subpart for that well or group of wells. If you previously met the source category definition for subpart UU of this part for a project where CO<sub>2</sub> is injected in enhanced recovery operations for oil and other hydrocarbons (CO<sub>2</sub>-EOR) and then began using the standard designated as CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7) such that you met the definition of the source category for subpart VV during a reporting year, you must report under subpart UU for the portion of the year before you began using CSA/ANSI ISO 27916:19 and report under subpart VV for the portion of the year after you began using CSA/ANSI ISO 27916:19.
- (d) A facility that is subject to this part only because it is subject to subpart UU of this part is not required to report emissions under subpart C of this part or any other subpart listed in § 98.2(a)(1) or (2).



[75 FR 75086, Dec. 1, 2010, as amended at 89 FR 31948, Apr. 25, 2024]

### § 98.471 Reporting threshold.

- (a) You must report under this subpart if your facility injects any amount of CO<sub>2</sub> into the subsurface.
- (b) For purposes of this subpart, any reference to CO<sub>2</sub> emissions in § 98.2(i) shall mean CO<sub>2</sub> received.

### § 98.472 GHGs to report.

You must report the mass of CO<sub>2</sub> received.

### § 98.473 Calculating CO<sub>2</sub> received.

- (a) You must calculate and report the annual mass of CO<sub>2</sub> received by pipeline using the procedures in paragraphs (a)(1) or (a)(2) of this section and the procedures in paragraph (a)(3) of this section, if applicable.
  - (1) For a mass flow meter, you must calculate the total annual mass of CO<sub>2</sub> in a CO<sub>2</sub> stream received in metric tons by multiplying the mass flow by the CO<sub>2</sub> concentration in the flow, according to Equation UU-1 of this section. You must collect these data quarterly. Mass flow and concentration data measurements must be made in accordance with § 98.474.

$$CO_{2T,r} = \sum_{p=1}^4 (Q_{r,p} - S_{r,p}) * C_{CO_{2,p,r}} \quad (\text{Eq. UU-1})$$

where:

CO<sub>2T,r</sub> = Net annual mass of CO<sub>2</sub> received through flow meter r (metric tons).

Q<sub>r,p</sub> = Quarterly mass flow through a receiving flow meter r in quarter p (metric tons).

S<sub>r,p</sub> = Quarterly mass flow through a receiving flow meter r that is redelivered to another facility without being injected into your well in quarter p (metric tons).

C<sub>CO<sub>2</sub>,p,r</sub> = Quarterly CO<sub>2</sub> concentration measurement in flow for flow meter r in quarter p (wt. percent CO<sub>2</sub>, expressed as a decimal fraction).

p = Quarter of the year.

r = Receiving flow meter.

- (2) For a volumetric flow meter, you must calculate the total annual mass of CO<sub>2</sub> in a CO<sub>2</sub> stream received in metric tons by multiplying the volumetric flow at standard conditions by the CO<sub>2</sub> concentration in the flow and the density of CO<sub>2</sub> at standard conditions, according to Equation UU-2 of this section. You must collect these data quarterly. Volumetric flow and concentration data measurements must be made in accordance with § 98.474.

$$CO_{2T,r} = \sum_{p=1}^4 (Q_{r,p} - S_{r,p}) * D * C_{CO_{2,p,r}} \quad (\text{Eq. UU-2})$$

where:

$CO_{2T,r}$  = Net annual mass of  $CO_2$  received through flow meter r (metric tons).

$Q_{r,p}$  = Quarterly volumetric flow through a receiving flow meter r in quarter p at standard conditions (standard cubic meters).

$S_{r,p}$  = Quarterly volumetric flow through a receiving flow meter r that is redelivered to another facility without being injected into your well in quarter p (standard cubic meters).

D = Density of  $CO_2$  at standard conditions (metric tons per standard cubic meter): 0.0018682.

$C_{CO_{2,p,r}}$  = Quarterly  $CO_2$  concentration measurement in flow for flow meter r in quarter p (vol. percent  $CO_2$ , expressed as a decimal fraction).

p = Quarter of the year.

r = Receiving flow meter.

- (3) If you receive  $CO_2$  through more than one flow meter, you must sum the mass of all  $CO_2$  received in accordance with the procedure specified in Equation UU-3 of this section.

$$CO_2 = \sum_{r=1}^R CO_{2T,r} \quad (\text{Eq. UU-3})$$

where:

$CO_2$  = Total net annual mass of  $CO_2$  received (metric tons).

$CO_{2T,r}$  = Net annual mass of  $CO_2$  received (metric tons) as calculated in Equation UU-1 or UU-2 for flow meter r.

r = Receiving flow meter.

- (b) You must calculate and report the annual mass of  $CO_2$  received in containers using the procedures specified in either paragraph (b)(1) or (b)(2) of this section.

- (1) If you are measuring the mass of contents in a container under the provisions of § 98.474(a)(2)(i), you must calculate the  $CO_2$  received in containers using Equation UU-1 of this section.

where:

$CO_{2T,r}$  = Annual mass of  $CO_2$  received in containers r (metric tons).

$C_{CO_2,p,r}$  = Quarterly  $CO_2$  concentration measurement of contents in containers  $r$  in quarter  $p$  (wt. percent  $CO_2$ , expressed as a decimal fraction).

$Q_{r,p}$  = Quarterly mass of contents in containers  $r$  in quarter  $p$  (metric tons).

$S_{r,p}$  = Quarterly mass of contents in containers  $r$  that is redelivered to another facility without being injected into your well in quarter  $p$  (standard cubic meters).

$p$  = Quarter of the year.

$r$  = Containers.

- (2) If you are measuring the volume of contents in a container under the provisions of § 98.474(a)(2)(ii), you must calculate the  $CO_2$  received in containers using Equation UU-2 of this section.

where:

$CO_{2T,r}$  = Annual mass of  $CO_2$  received in containers  $r$  (metric tons).

$C_{CO_2,p,r}$  = Quarterly  $CO_2$  concentration measurement of contents in containers  $r$  in quarter  $p$  (vol. percent  $CO_2$ , expressed as a decimal fraction).

$S_{r,p}$  = Quarterly volume of contents in containers  $r$  that is redelivered to another facility without being injected into your well in quarter  $p$  (standard cubic meters).

$Q_{r,p}$  = Quarterly volume of contents in containers  $r$  in quarter  $p$  (standard cubic meters).

$D$  = Density of the  $CO_2$  received in containers at standard conditions (metric tons per standard cubic meter): 0.0018682.

$p$  = Quarter of the year.

$r$  = Containers.

[75 FR 75078, Dec. 1, 2010, as amended at 78 FR 71981, Nov. 29, 2013]

## § 98.474 Monitoring and QA/QC requirements.

### (a) $CO_2$ received.

- (1) You must determine the quarterly flow rate of  $CO_2$  received by pipeline by following the most appropriate of the following procedures:
- (i) You may measure flow rate at the receiving custody transfer meter prior to any subsequent processing operations at the facility and collect the flow rate quarterly.
  - (ii) If you took ownership of the  $CO_2$  in a commercial transaction, you may use the quarterly flow rate data from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.

- (iii) If you inject CO<sub>2</sub> from a production process unit that is part of your facility, you may use the quarterly CO<sub>2</sub> flow rate that was measured at the equivalent of a custody transfer meter following procedures provided in subpart PP of this part. To be the equivalent of a custody transfer meter, a meter must measure the flow of CO<sub>2</sub> being transported to an injection well to the same degree of accuracy as a meter used for commercial transactions.
- (2) You must determine the quarterly mass or volume of contents in all containers if you receive CO<sub>2</sub> in containers by the most appropriate of the following procedures:
  - (i) You may measure the mass of contents of containers summed quarterly using weigh bills, scales, or load cells.
  - (ii) You may determine the volume of the contents of containers summed quarterly.
  - (iii) If you took ownership of the CO<sub>2</sub> in a commercial transaction, you may use the quarterly mass or volume of contents from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.
- (3) You must determine a quarterly concentration of the CO<sub>2</sub> received that is representative of all CO<sub>2</sub> received in that quarter by following the most appropriate of the following procedures:
  - (i) You may sample the CO<sub>2</sub> stream at least once per quarter at the point of receipt and measure its CO<sub>2</sub> concentration.
  - (ii) If you took ownership of the CO<sub>2</sub> in a commercial transaction for which the sales contract was contingent on CO<sub>2</sub> concentration, and if the supplier of the CO<sub>2</sub> sampled the CO<sub>2</sub> stream in a quarter and measured its concentration per the sales contract terms, you may use the CO<sub>2</sub> concentration data from the sales contract for that quarter.
  - (iii) If you inject CO<sub>2</sub> from a production process unit that is part of your facility, you may report the quarterly CO<sub>2</sub> concentration of the CO<sub>2</sub> stream supplied that was measured following procedures provided in subpart PP of this part as the quarterly CO<sub>2</sub> concentration of the CO<sub>2</sub> stream received.
- (4) You must assume that the CO<sub>2</sub> you receive meets the definition of a CO<sub>2</sub> stream unless you can trace it through written records to a source other than a CO<sub>2</sub> stream.

(b) **Measurement devices.**

- (1) All flow meters must be operated continuously except as necessary for maintenance and calibration.
- (2) You must calibrate all flow meters used to measure quantities reported in § 98.476 according to the calibration and accuracy requirements in § 98.3(i).
- (3) You must operate all measurement devices according to one of the following. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or an industry standard practice. Consensus-based standards organizations include, but are not limited to, the following: ASTM International, the American National Standards Institute (ANSI), the American Gas Association (AGA), the American Society of Mechanical Engineers (ASME), the American Petroleum Institute (API), and the North American Energy Standards Board (NAESB).
- (4) You must ensure that any flow meter calibrations performed are National Institute of Standards and Technology (NIST) traceable.

(c) **General.**

- (1) If you measure the concentration of any CO<sub>2</sub> quantity for reporting, you must measure according to one of the following. You may use an appropriate standard method published by a consensus-based standards organization if such a method exists or an industry standard practice.
- (2) You must convert all measured volumes of CO<sub>2</sub> to the following standard industry temperature and pressure conditions for use in Equation UU-2 of this subpart: Standard cubic meters at a temperature of 60 degrees Fahrenheit and at an absolute pressure of 1 atmosphere.
- (3) For 2011, you may follow the provisions of § 98.3(d)(1) through (2) for best available monitoring methods rather than follow the monitoring requirements of this section. For purposes of this subpart, any reference to the year 2010 in § 98.3(d)(1) through (2) shall mean 2011.

[75 FR 75086, Dec. 1, 2010, as amended at 81 FR 89274, Dec. 9, 2016]

**§ 98.475 Procedures for estimating missing data.**

A complete record of all measured parameters used in the GHG quantities calculations is required.

- (a) Whenever the monitoring procedures for all facilities that used flow meters covered under this subpart cannot be followed to measure flow, the following missing data procedures must be followed:
  - (1) Another calculation methodology listed in § 98.474(a)(1) must be used if possible.
  - (2) If another method listed in § 98.474(a)(1) cannot be used, a quarterly flow rate value that is missing must be estimated using a representative flow rate value from the nearest previous time period.
- (b) Whenever the monitoring procedures of this subpart cannot be followed to measure quarterly quantity of CO<sub>2</sub> received in containers, the most appropriate of the following missing data procedures must be followed:
  - (1) Another calculation methodology listed in § 98.474(a)(2) must be used if possible.
  - (2) If another method listed in § 98.474(a)(2) cannot be used, a quarterly mass or volume that is missing must be estimated using a representative mass or volume from the nearest previous time period.
- (c) Whenever the monitoring procedures cannot be followed to measure CO<sub>2</sub> concentration, the following missing data procedures must be followed:
  - (1) Another calculation methodology listed in § 98.474(a)(3) must be used if possible.
  - (2) If another method listed in § 98.474(a)(3) cannot be used, a quarterly concentration value that is missing must be estimated using a representative concentration value from the nearest previous time period.

**§ 98.476 Data reporting requirements.**

If you are subject to this part and report under this subpart, you are not required to report the information in § 98.3(c)(4) for this subpart. In addition to the information required by § 98.3(c)(1) through § 98.3(c)(3) and by § 98.3(c)(5) through § 98.3(c)(9), you must report the information listed in this section.

- (a) If you receive CO<sub>2</sub> by pipeline, report the following for each receiving flow meter:

- (1) The total net mass of CO<sub>2</sub> received (metric tons) annually.
  - (2) If a volumetric flow meter is used to receive CO<sub>2</sub>:
    - (i) The volumetric flow through a receiving flow meter at standard conditions (in standard cubic meters) in each quarter.
    - (ii) The volumetric flow through a receiving flow meter that is redelivered to another facility without being injected into your well (in standard cubic meters) in each quarter.
    - (iii) The CO<sub>2</sub> concentration in the flow (volume percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
  - (3) If a mass flow meter is used to receive CO<sub>2</sub>:
    - (i) The mass flow through a receiving flow meter (in metric tons) in each quarter.
    - (ii) The mass flow through a receiving flow meter that is redelivered to another facility without being injected into your well (in metric tons) in each quarter.
    - (iii) The CO<sub>2</sub> concentration in the flow (weight percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
  - (4) The standard or method used to calculate each value in paragraphs (a)(2) through (a)(3) of this section.
  - (5) The number of times in the reporting year for which substitute data procedures were used to calculate values reported in paragraphs (a)(2) through (a)(3) of this section.
  - (6) Whether the flow meter is mass or volumetric.
- (b) If you receive CO<sub>2</sub> in containers, report:
- (1) The mass (in metric tons) or volume at standard conditions (in standard cubic meters) of contents in containers in each quarter.
  - (2) The concentration of CO<sub>2</sub> of contents in containers (volume or weight percent CO<sub>2</sub> expressed as a decimal fraction) in each quarter.
  - (3) The mass (in metric tons) or volume (in standard cubic meters) of contents in containers that is redelivered to another facility without being injected into your well in each quarter.
  - (4) The net total mass of CO<sub>2</sub> received (in metric tons) annually.
  - (5) The standard or method used to calculate each value in paragraphs (b)(1), (b)(2), and (b)(3) of this section.
  - (6) The number of times in the reporting year for which substitute data procedures were used to calculate values reported in paragraphs (b)(1) and (b)(2) of this section.
- (c) If you use more than one receiving flow meter, report the net total mass of CO<sub>2</sub> received (metric tons) through all flow meters annually.
- (d) The source of the CO<sub>2</sub> received according to the following categories:
- (1) CO<sub>2</sub> production wells.
  - (2) Electric generating unit.

- (3) Ethanol plant.
- (4) Pulp and paper mill.
- (5) Natural gas processing.
- (6) Gasification operations.
- (7) Other anthropogenic source.
- (8) Discontinued enhanced oil and gas recovery project.
- (9) Unknown.
- (e) Report the following:
  - (1) Whether the facility received a Research and Development project exemption from reporting under 40 CFR part 98, subpart RR, for this reporting year. If you received an exemption, report the start and end dates of the exemption approved by EPA.
  - (2) Whether the facility includes a well or group of wells where a CO<sub>2</sub> stream was injected into subsurface geologic formations to enhance the recovery of oil during this reporting year.
  - (3) Whether the facility includes a well or group of wells where a CO<sub>2</sub> stream was injected into subsurface geologic formations to enhance the recovery of natural gas during this reporting year.
  - (4) Whether the facility includes a well or group of wells where a CO<sub>2</sub> stream was injected into subsurface geologic formations for acid gas disposal during this reporting year.
  - (5) Whether the facility includes a well or group of wells where a CO<sub>2</sub> stream was injected for a purpose other than those listed in paragraphs (e)(1) through (4) of this section. If you injected CO<sub>2</sub> for another purpose, report the purpose of the injection.

[75 FR 75078, Dec. 1, 2010, as amended at 78 FR 71981, Nov. 29, 2013]

### § 98.477 Records that must be retained.

- (a) You must follow the record retention requirements specified by § 98.3(g). In addition to the records required by § 98.3(g), you must retain quarterly records of CO<sub>2</sub> received, including mass flow rate or contents of containers (mass or volumetric) at standard conditions and operating conditions, operating temperature and pressure, and concentration of these streams. You must retain all required records for at least 3 years.
- (b) You must complete your monitoring plans, as described in § 98.3(g)(5), by April 1 of the year you begin collecting data.

### § 98.478 Definitions.

Except as provided below, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

*CO<sub>2</sub> received* means the CO<sub>2</sub> stream that you receive to be injected for the first time into a well on your facility that is covered by this subpart. CO<sub>2</sub> received includes, but is not limited to, a CO<sub>2</sub> stream from a production process unit inside your facility and a CO<sub>2</sub> stream that was injected into a well on another facility, removed from a discontinued enhanced oil or natural gas or other production well, and transferred to your facility.

## Subpart VV—Geologic Sequestration of Carbon Dioxide With Enhanced Oil Recovery Using ISO 27916

**Source:** 89 FR 31948, Apr. 25, 2024, unless otherwise noted.

### § 98.480 Definition of the source category.

- (a) This source category pertains to carbon dioxide (CO<sub>2</sub>) that is injected in enhanced recovery operations for oil and other hydrocarbons (CO<sub>2</sub>-EOR) in which all of the following apply:
  - (1) You are using the standard designated as CSA/ANSI ISO 27916:19, (incorporated by reference, see § 98.7) as a method of quantifying geologic sequestration of CO<sub>2</sub> in association with EOR operations.
  - (2) You are not reporting under subpart RR of this part.
- (b) This source category does not include wells permitted as Class VI under the Underground Injection Control program.
- (c) If you are subject to only this subpart, you are not required to report emissions under subpart C of this part or any other subpart listed in § 98.2(a)(1) or (2).

### § 98.481 Reporting threshold.

- (a) You must report under this subpart if your CO<sub>2</sub>-EOR project uses CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7) as a method of quantifying geologic sequestration of CO<sub>2</sub> in association with CO<sub>2</sub>-EOR operations. There is no threshold for reporting.
- (b) The requirements of § 98.2(i) do not apply to this subpart. Once a CO<sub>2</sub>-EOR project becomes subject to the requirements of this subpart, you must continue for each year thereafter to comply with all requirements of this subpart, including the requirement to submit annual reports until the facility has met the requirements of paragraphs (b)(1) and (2) of this section and submitted a notification to discontinue reporting according to paragraph (b)(3) of this section.
  - (1) Discontinuation of reporting under this subpart must follow the requirements set forth under Clause 10 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).
  - (2) CO<sub>2</sub>-EOR project termination is completed when all of the following occur:
    - (i) Cessation of CO<sub>2</sub> injection.
    - (ii) Cessation of hydrocarbon production from the project reservoir; and
    - (iii) Wells are plugged and abandoned unless otherwise required by the appropriate regulatory authority.
  - (3) You must notify the Administrator of your intent to cease reporting and provide a copy of the CO<sub>2</sub>-EOR project termination documentation.



- (c) If you previously met the source category definition for subpart UU of this part for your CO<sub>2</sub>-EOR project and then began using CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7) as a method of quantifying geologic sequestration of CO<sub>2</sub> in association with CO<sub>2</sub>-EOR operations during a reporting year, you must report under subpart UU of this part for the portion of the year before you began using CSA/ANSI ISO 27916:19 and report under subpart VV for the portion of the year after you began using CSA/ANSI ISO 27916:19.

### § 98.482 GHGs to report.

You must report the following from Clause 8 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7):

- (a) The mass of CO<sub>2</sub> received by the CO<sub>2</sub>-EOR project.
- (b) The mass of CO<sub>2</sub> loss from the CO<sub>2</sub>-EOR project operations.
- (c) The mass of native CO<sub>2</sub> produced and captured.
- (d) The mass of CO<sub>2</sub> produced and sent off-site.
- (e) The mass of CO<sub>2</sub> loss from the EOR complex.
- (f) The mass of CO<sub>2</sub> stored in association with CO<sub>2</sub>-EOR.

### § 98.483 Calculating CO<sub>2</sub> geologic sequestration.

You must calculate CO<sub>2</sub> sequestered using the following quantification principles from Clause 8.2 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).

- (a) You must calculate the mass of CO<sub>2</sub> stored in association with CO<sub>2</sub>-EOR ( $m_{\text{stored}}$ ) in the reporting year by subtracting the mass of CO<sub>2</sub> loss from operations and the mass of CO<sub>2</sub> loss from the EOR complex from the total mass of CO<sub>2</sub> input (as specified in equation 1 to this paragraph (a)).

#### Equation 1 to paragraph (a)

$$m_{\text{stored}} = m_{\text{input}} - m_{\text{loss operations}} - m_{\text{loss EOR complex}}$$

Where:

$m_{\text{stored}}$  = The annual quantity of associated storage in metric tons of CO<sub>2</sub> mass.

$m_{\text{input}}$  = The total mass of CO<sub>2</sub>  $m_{\text{received}}$  by the EOR project plus  $m_{\text{native}}$  (see Clause 8.3 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7) and paragraph (c) of this section), metric tons. Native CO<sub>2</sub> produced and captured in the CO<sub>2</sub>-EOR project ( $m_{\text{native}}$ ) can be quantified and included in  $m_{\text{input}}$ .

$m_{\text{loss operations}}$  = The total mass of CO<sub>2</sub> loss from project operations (see Clauses 8.4.1 through 8.4.5 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7) and paragraph (d) of this section), metric tons.

$m_{\text{loss EOR complex}}$  = The total mass of CO<sub>2</sub> loss from the EOR complex (see Clause 8.4.6 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)), metric tons.

- (b) The manner by which associated storage is quantified must assure completeness and preclude double counting. The annual mass of CO<sub>2</sub> that is recycled and reinjected into the EOR complex must not be quantified as associated storage. Loss from the CO<sub>2</sub> recycling facilities must be quantified.
- (c) You must quantify the total mass of CO<sub>2</sub> input ( $m_{\text{input}}$ ) in the reporting year according to paragraphs (g)(1) through (3) of this section.
  - (1) You must include the total mass of CO<sub>2</sub> received at the custody transfer meter by the CO<sub>2</sub>-EOR project ( $m_{\text{received}}$ ).
  - (2) The CO<sub>2</sub> stream received (including CO<sub>2</sub> transferred from another CO<sub>2</sub>-EOR project) must be metered.
    - (i) The native CO<sub>2</sub> recovered and included as  $m_{\text{native}}$  must be documented.
    - (ii) CO<sub>2</sub> delivered to multiple CO<sub>2</sub>-EOR projects must be allocated among those CO<sub>2</sub>-EOR projects.
  - (3) The sum of the quantities of allocated CO<sub>2</sub> must not exceed the total quantities of CO<sub>2</sub> received.
- (d) You must calculate the total mass of CO<sub>2</sub> from project operations ( $m_{\text{loss operations}}$ ) in the reporting year as specified in equation 2 to this paragraph (d).

#### Equation 2 to paragraph (d)

$$m_{\text{loss operations}} = m_{\text{loss leakage facilities}} + m_{\text{loss vent/flare}} + m_{\text{loss entrained}} + m_{\text{loss transfer}}$$

Where:

$m_{\text{loss leakage facilities}}$  = Loss of CO<sub>2</sub> due to leakage from production, handling, and recycling CO<sub>2</sub>-EOR facilities (infrastructure including wellheads), metric tons.

$m_{\text{loss vent/flare}}$  = Loss of CO<sub>2</sub> from venting/flaring from production operations, metric tons.

$m_{\text{loss entrained}}$  = Loss of CO<sub>2</sub> due to entrainment within produced gas/oil/water when this CO<sub>2</sub> is not separated and reinjected, metric tons.

$m_{\text{loss transfer}}$  = Loss of CO<sub>2</sub> due to any transfer of CO<sub>2</sub> outside the CO<sub>2</sub>-EOR project, metric tons. You must quantify any CO<sub>2</sub> that is subsequently produced from the EOR complex and transferred offsite.

#### § 98.484 Monitoring and QA/QC requirements.

You must use the applicable monitoring and quality assurance requirements set forth in Clause 6.2 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).

#### § 98.485 Procedures for estimating missing data.

Whenever the value of a parameter is unavailable or the quality assurance procedures set forth in § 98.484 cannot be followed, you must follow the procedures set forth in Clause 9.2 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).

## § 98.486 Data reporting requirements.

In addition to the information required by § 98.3(c), the annual report shall contain the following information, as applicable:

- (a) The annual quantity of associated storage in metric tons of CO<sub>2</sub> ( $m_{\text{stored}}$ ).
- (b) The density of CO<sub>2</sub> if volumetric units are converted to mass in order to be reported for annual quantity of CO<sub>2</sub> stored.
- (c) The annual quantity of CO<sub>2</sub> input ( $m_{\text{input}}$ ) and the information in paragraphs (c)(1) and (2) of this section.
  - (1) The annual total mass of CO<sub>2</sub> received at the custody transfer meter by the CO<sub>2</sub>-EOR project, including CO<sub>2</sub> transferred from another CO<sub>2</sub>-EOR project ( $m_{\text{received}}$ ).
  - (2) The annual mass of native CO<sub>2</sub> produced and captured in the CO<sub>2</sub>-EOR project ( $m_{\text{native}}$ ).
- (d) The annual mass of CO<sub>2</sub> that is recycled and reinjected into the EOR complex.
- (e) The annual total mass of CO<sub>2</sub> loss from project operations ( $m_{\text{loss operations}}$ ), and the information in paragraphs (e)(1) through (4) of this section.
  - (1) Loss of CO<sub>2</sub> due to leakage from production, handling, and recycling CO<sub>2</sub>-EOR facilities (infrastructure including wellheads) ( $m_{\text{loss leakage facilities}}$ ).
  - (2) Loss of CO<sub>2</sub> from venting/flaring from production operations ( $m_{\text{loss vent/flare}}$ ).
  - (3) Loss of CO<sub>2</sub> due to entrainment within produced gas/oil/water when this CO<sub>2</sub> is not separated and reinjected ( $m_{\text{loss entrained}}$ ).
  - (4) Loss of CO<sub>2</sub> due to any transfer of CO<sub>2</sub> outside the CO<sub>2</sub>-EOR project ( $m_{\text{loss transfer}}$ ).
- (f) The total mass of CO<sub>2</sub> loss from the EOR complex ( $m_{\text{loss EOR complex}}$ ).
- (g) Annual documentation that contains the following components as described in Clause 4.4 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7):
  - (1) The formulas used to quantify the annual mass of associated storage, including the mass of CO<sub>2</sub> delivered to the CO<sub>2</sub>-EOR project and losses during the period covered by the documentation (see Clause 8 and Annex B of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (2) The methods used to estimate missing data and the amounts estimated as described in Clause 9.2 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).
  - (3) The approach and method for quantification utilized by the operator, including accuracy, precision, and uncertainties (see Clause 8 and Annex B of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (4) A statement describing the nature of validation or verification including the date of review, process, findings, and responsible person or entity.
  - (5) Source of each CO<sub>2</sub> stream quantified as associated storage (see Clause 8.3 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (6) A description of the procedures used to detect and characterize the total CO<sub>2</sub> leakage from the EOR complex.

- (7) If only the mass of anthropogenic CO<sub>2</sub> is considered for mstored, a description of the derivation and application of anthropogenic CO<sub>2</sub> allocation ratios for all the terms described in Clauses 8.1 to 8.4.6 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).
- (8) Any documentation provided by a qualified independent engineer or geologist, who certifies that the documentation provided, including the mass balance calculations as well as information regarding monitoring and containment assurance, is accurate and complete.
- (h) Any changes made within the reporting year to containment assurance and monitoring approaches and procedures in the EOR operations management plan.

### § 98.487 Records that must be retained.

You must follow the record retention requirements specified by § 98.3(g). In addition to the records required by § 98.3(g), you must comply with the record retention requirements in Clause 9.1 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).

### § 98.488 EOR Operations Management Plan.

- (a) You must prepare and update, as necessary, a general EOR operations management plan that provides a description of the EOR complex and engineered system (see Clause 4.3(a) of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)), establishes that the EOR complex is adequate to provide safe, long-term containment of CO<sub>2</sub>, and includes site-specific and other information including:
  - (1) Geologic characterization of the EOR complex.
  - (2) A description of the facilities within the CO<sub>2</sub>-EOR project.
  - (3) A description of all wells and other engineered features in the CO<sub>2</sub>-EOR project.
  - (4) The operations history of the project reservoir.
  - (5) The information set forth in Clauses 5 and 6 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).
- (b) You must prepare initial documentation at the beginning of the quantification period, and include the following as described in the EOR operations management plan:
  - (1) A description of the EOR complex and engineered systems (see Clause 5 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (2) The initial containment assurance (see Clause 6.1.2 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (3) The monitoring program (see Clause 6.2 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (4) The quantification method to be used (see Clause 8 and Annex B of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).
  - (5) The total mass of previously injected CO<sub>2</sub> (if any) within the EOR complex at the beginning of the CO<sub>2</sub>-EOR project (see Clause 8.5 and Annex B of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7)).

- (c) The EOR operation management plan in paragraph (a) of this section and initial documentation in paragraph (b) of this section must be submitted to the Administrator with the annual report covering the first reporting year that the facility reports under this subpart. In addition, any documentation provided by a qualified independent engineer or geologist, who certifies that the documentation provided is accurate and complete, must also be provided to the Administrator.
- (d) If the EOR operations management plan is updated, the updated EOR management plan must be submitted to the Administrator with the annual report covering the first reporting year for which the updated EOR operation management plan is applicable.

## § 98.489 Definitions.

Except as provided in paragraphs (a) and (b) of this section, all terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

Additional terms and definitions are provided in Clause 3 of CSA/ANSI ISO 27916:19 (incorporated by reference, see § 98.7).

## Subpart WW—Coke Calciners

**Source:** 89 FR 31948, Apr. 25, 2024, unless otherwise noted.

## § 98.490 Definition of the source category.

- (a) A coke calciner is a process unit that heats petroleum coke to high temperatures for the purpose of removing impurities or volatile substances in the petroleum coke feedstock.
- (b) This source category consists of rotary kilns, rotary hearth furnaces, or similar process units used to calcine petroleum coke and also includes afterburners or other emission control systems used to treat the coke calcining unit's process exhaust gas.

## § 98.491 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a coke calciner and the facility meets the requirements of either § 98.2(a)(1) or (2).

## § 98.492 GHGs to report.

You must report:

- (a) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each coke calcining unit under this subpart.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from auxiliary fuel used in the coke calcining unit and afterburner, if applicable, or other control system used to treat the coke calcining unit's process off-gas under subpart C of this part by following the requirements of subpart C.

## § 98.493 Calculating GHG emissions.

- (a) Calculate GHG emissions required to be reported in § 98.492(a) using the applicable methods in paragraph (b) of this section.

- (b) For each coke calcining unit, calculate GHG emissions according to the applicable provisions in paragraphs (b)(1) through (4) of this section.
- (1) If you operate and maintain a CEMS that measures CO<sub>2</sub> emissions according to subpart C of this part, you must calculate and report CO<sub>2</sub> emissions under this subpart by following the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part. Auxiliary fuel use CO<sub>2</sub> emissions should be calculated in accordance with subpart C of this part and subtracted from the CO<sub>2</sub> CEMS emissions to determine process CO<sub>2</sub> emissions. Other coke calcining units must either install a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part or follow the requirements of paragraph (b)(2) of this section.
- (2) Calculate the CO<sub>2</sub> emissions from the coke calcining unit using monthly measurements and equation 1 to this paragraph (b)(2).

Equation 1 to paragraph (b)(2)

$$CO_2 = \frac{44}{12} \times \sum_{m=1}^{12} (M_{in,m} \times CC_{GC,m} - (M_{out,m} + M_{dust,m}) \times CC_{MPC,m})$$

Where:

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions (metric tons CO<sub>2</sub>/year).

m = Month index.

M<sub>in,m</sub> = Mass of green coke fed to the coke calcining unit in month “m” from facility records (metric tons/year).

CC<sub>GC,m</sub> = Mass fraction carbon content of green coke fed to the coke calcining unit from facility measurement data in month “m” (metric ton carbon/metric ton green coke). If measurements are made more frequently than monthly, determine the monthly average as the arithmetic average for all measurements made during the calendar month.

M<sub>out,m</sub> = Mass of marketable petroleum coke produced by the coke calcining unit in month “m” from facility records (metric tons petroleum coke/year).

M<sub>dust,m</sub> = Mass of petroleum coke dust removed from the process through the dust collection system of the coke calcining unit in month “m” from facility records (metric ton petroleum coke dust/year). For coke calcining units that recycle the collected dust, the mass of coke dust removed from the process is the mass of coke dust collected less the mass of coke dust recycled to the process.

CC<sub>MPC,m</sub> = Mass fraction carbon content of marketable petroleum coke produced by the coke calcining unit in month “m” from facility measurement data (metric ton carbon/metric ton petroleum coke). If measurements are made more frequently than monthly, determine the monthly average as the arithmetic average for all measurements made during the calendar month.

44 = Molecular weight of CO<sub>2</sub> (kg/kg-mole).

12 = Atomic weight of C (kg/kg-mole).

- (3) Calculate CH<sub>4</sub> emissions using equation 2 to this paragraph (b)(3).

Equation 2 to paragraph (b)(3)

$$\text{CH}_4 = \left( \text{CO}_2 \times \frac{\text{EmF}_2}{\text{EmF}_1} \right)$$

Where:

CH<sub>4</sub> = Annual methane emissions (metric tons CH<sub>4</sub>/year).

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions calculated in paragraph (b)(1) or (2) of this section, as applicable (metric tons CO<sub>2</sub>/year).

EmF<sub>1</sub> = Default CO<sub>2</sub> emission factor for petroleum coke from table C-1 to subpart C of this part (kg CO<sub>2</sub>/MMBtu).

EmF<sub>2</sub> = Default CH<sub>4</sub> emission factor for "Petroleum Products (All fuel types in table C-1)" from table C-2 to subpart C of this part (kg CH<sub>4</sub>/MMBtu).

- (4) Calculate N<sub>2</sub>O emissions using equation 3 to this paragraph (b)(4).

Equation 3 to paragraph (b)(4)

$$\text{N}_2\text{O} = \left( \text{CO}_2 \times \frac{\text{EmF}_3}{\text{EmF}_1} \right)$$

Where:

N<sub>2</sub>O = Annual nitrous oxide emissions (metric tons N<sub>2</sub>O/year).

CO<sub>2</sub> = Annual CO<sub>2</sub> emissions calculated in paragraph (b)(1) or (2) of this section, as applicable (metric tons CO<sub>2</sub>/year).

EmF<sub>1</sub> = Default CO<sub>2</sub> emission factor for petroleum coke from table C-1 to subpart C of this part (kg CO<sub>2</sub>/MMBtu).

EmF<sub>3</sub> = Default N<sub>2</sub>O emission factor for "Petroleum Products (All fuel types in table C-1)" from table C-2 to subpart C of this part (kg N<sub>2</sub>O/MMBtu).

**§ 98.494 Monitoring and QA/QC requirements.**

- (a) Flow meters, gas composition monitors, and heating value monitors that are associated with sources that use a CEMS to measure CO<sub>2</sub> emissions according to subpart C of this part or that are associated with stationary combustion sources must meet the applicable monitoring and QA/QC requirements in § 98.34.
- (b) Determine the mass of petroleum coke monthly as required by equation 1 to § 98.493(b)(2) using mass measurement equipment meeting the requirements for commercial weighing equipment as described in NIST HB 44-2023 (incorporated by reference, see § 98.7). Calibrate the measurement device according to

the procedures specified by NIST HB 44-2023 (incorporated by reference, see § 98.7) or the procedures specified by the manufacturer. Recalibrate either biennially or at the minimum frequency specified by the manufacturer.

- (c) Determine the carbon content of petroleum coke as required by equation 1 § 98.493(b)(2) using any one of the following methods. Calibrate the measurement device according to procedures specified by the method or procedures specified by the measurement device manufacturer.
  - (1) ASTM D3176-15 (incorporated by reference, see § 98.7).
  - (2) ASTM D5291-16 (incorporated by reference, see § 98.7).
  - (3) ASTM D5373-21 (incorporated by reference, see § 98.7).
- (d) The owner or operator must document the procedures used to ensure the accuracy of the monitoring systems used including but not limited to calibration of weighing equipment, flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded.

### § 98.495 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required (e.g., concentrations, flow rates, fuel heating values, carbon content values). Therefore, whenever a quality-assured value of a required parameter is unavailable (e.g., if a CEMS malfunctions during unit operation or if a required sample is not taken), a substitute data value for the missing parameter must be used in the calculations.

- (a) For missing auxiliary fuel use data, use the missing data procedures in subpart C of this part.
- (b) For each missing value of mass or carbon content of coke, substitute the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If the “after” value is not obtained by the end of the reporting year, you may use the “before” value for the missing data substitution. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value must be the first quality-assured value obtained after the missing data period.
- (c) For missing CEMS data, you must use the missing data procedures in § 98.35.

### § 98.496 Data reporting requirements.

In addition to the reporting requirements of § 98.3(c), you must report the information specified in paragraphs (a) through (i) of this section for each coke calcining unit.

- (a) The unit ID number (if applicable).
- (b) Maximum rated throughput of the unit, in metric tons coke calcined/stream day.
- (c) The calculated CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O annual process emissions, expressed in metric tons of each pollutant emitted.
- (d) A description of the method used to calculate the CO<sub>2</sub> emissions for each unit (e.g., CEMS or equation 1 to § 98.493(b)(2)).
- (e) Annual mass of green coke fed to the coke calcining unit from facility records (metric tons/year).



- (f) Annual mass of marketable petroleum coke produced by the coke calcining unit from facility records (metric tons/year).
- (g) Annual mass of petroleum coke dust removed from the process through the dust collection system of the coke calcining unit from facility records (metric tons/year) and an indication of whether coke dust is recycled to the unit (e.g., all dust is recycled, a portion of the dust is recycled, or none of the dust is recycled).
- (h) Annual average mass fraction carbon content of green coke fed to the coke calcining unit from facility measurement data (metric tons C per metric ton green coke).
- (i) Annual average mass fraction carbon content of marketable petroleum coke produced by the coke calcining unit from facility measurement data (metric tons C per metric ton petroleum coke).

### § 98.497 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) and (b) of this section.

- (a) The records of all parameters monitored under § 98.494.
- (b) The applicable verification software records as identified in this paragraph (b). You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (b)(1) through (5) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (b)(1) through (5) of this section.
  - (1) Monthly mass of green coke fed to the coke calcining unit from facility records (metric tons/year) (equation 1 to § 98.493(b)(2)).
  - (2) Monthly mass of marketable petroleum coke produced by the coke calcining unit from facility records (metric tons/year) (equation 1 to § 98.493(b)(2)).
  - (3) Monthly mass of petroleum coke dust removed from the process through the dust collection system of the coke calcining unit from facility records (metric tons/year) (equation 1 to § 98.493(b)(2)).
  - (4) Average monthly mass fraction carbon content of green coke fed to the coke calcining unit from facility measurement data (metric tons C per metric ton green coke) (equation 1 to § 98.493(b)(2)).
  - (5) Average monthly mass fraction carbon content of marketable petroleum coke produced by the coke calcining unit from facility measurement data (metric tons C per metric ton petroleum coke) (equation 1 to § 98.493(b)(2)).

### § 98.498 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

### Subpart XX—Calcium Carbide Production

**Source:** 89 FR 31948, Apr. 25, 2024, unless otherwise noted.

### § 98.500 Definition of the source category.

The calcium carbide production source category consists of any facility that produces calcium carbide.

### § 98.501 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a calcium carbide production process and the facility meets the requirements of either § 98.2(a)(1) or (2).

### § 98.502 GHGs to report.

You must report:

- (a) Process CO<sub>2</sub> emissions from each calcium carbide process unit or furnace used for the production of calcium carbide.
- (b) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O emissions from each stationary combustion unit following the requirements of subpart C of this part. You must report these emissions under subpart C of this part by following the requirements of subpart C.

### § 98.503 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each calcium carbide process unit not subject to paragraph (c) of this section using the procedures in either paragraph (a) or (b) of this section.

- (a) Calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining CEMS according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.
- (b) Calculate and report under this subpart the annual process CO<sub>2</sub> emissions from the calcium carbide process unit using the carbon mass balance procedure specified in paragraphs (b)(1) and (2) of this section.
  - (1) For each calcium carbide process unit, determine the annual mass of carbon in each carbon-containing input and output material for the calcium carbide process unit and estimate annual process CO<sub>2</sub> emissions from the calcium carbide process unit using equation 1 to this paragraph (b)(1). Carbon-containing input materials include carbon electrodes and carbonaceous reducing agents. If you document that a specific input or output material contributes less than 1 percent of the total carbon into or out of the process, you do not have to include the material in your calculation using equation 1.

#### Equation 1 to paragraph (b)(1)

$$\begin{aligned}
 E_{\text{CO}_2} = & \frac{44}{12} \times \frac{2000}{2205} \times \sum_1^i (M_{\text{reducing agent}_i} \times C_{\text{reducing agent}_i}) \\
 & + \frac{44}{12} \times \frac{2000}{2205} \times \sum_1^m (M_{\text{electrode}_m} \times C_{\text{electrode}_m}) \\
 & - \frac{44}{12} \times \frac{2000}{2205} \times \sum_1^k (M_{\text{product outgoing}_k} \times C_{\text{product outgoing}_k}) \\
 & - \frac{44}{12} \times \frac{2000}{2205} \times \sum_1^l (M_{\text{non-product outgoing}_l} \times C_{\text{non-product outgoing}_l})
 \end{aligned}$$

Where:

$E_{\text{CO}_2}$  = Annual process CO<sub>2</sub> emissions from an individual calcium carbide process unit (metric tons).

44/12 = Ratio of molecular weights, CO<sub>2</sub> to carbon.

2000/2205 = Conversion factor to convert tons to metric tons.

$M_{\text{reducing agent}_i}$  = Annual mass of reducing agent i fed, charged, or otherwise introduced into the calcium carbide process unit (tons).

$C_{\text{reducing agent}_i}$  = Carbon content in reducing agent i (percent by weight, expressed as a decimal fraction).

$M_{\text{electrode}_m}$  = Annual mass of carbon electrode m consumed in the calcium carbide process unit (tons).

$C_{\text{electrode}_m}$  = Carbon content of the carbon electrode m (percent by weight, expressed as a decimal fraction).

$M_{\text{product outgoing}_k}$  = Annual mass of alloy product k tapped from the calcium carbide process unit (tons).

$C_{\text{product outgoing}_k}$  = Carbon content in alloy product k (percent by weight, expressed as a decimal fraction).

$M_{\text{non-product outgoing}_l}$  = Annual mass of non-product outgoing material l removed from the calcium carbide unit (tons).

$C_{\text{non-product outgoing}_l}$  = Carbon content in non-product outgoing material l (percent by weight, expressed as a decimal fraction).

- (2) Determine the combined annual process CO<sub>2</sub> emissions from the calcium carbide process units at your facility using equation 2 to this paragraph (b)(2).

Equation 2 to paragraph (b)(2)

$$\text{CO}_2 = \sum 1^k E_{\text{CO}_2k}$$

Where:

$\text{CO}_2$  = Annual process  $\text{CO}_2$  emissions from calcium carbide process units at a facility used for the production of calcium carbide (metric tons).

$E_{\text{CO}_2k}$  = Annual process  $\text{CO}_2$  emissions calculated from calcium carbide process unit  $k$  calculated using equation 1 to paragraph (b)(1) of this section (metric tons).

$k$  = Total number of calcium carbide process units at facility.

- (c) If all GHG emissions from a calcium carbide process unit are vented through the same stack as any combustion unit or process equipment that reports  $\text{CO}_2$  emissions using a CEMS that complies with the Tier 4 Calculation Methodology in subpart C of this part, then the calculation methodology in paragraph (b) of this section must not be used to calculate process emissions. The owner or operator must report under this subpart the combined stack emissions according to the Tier 4 Calculation Methodology in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.

#### § 98.504 Monitoring and QA/QC requirements.

If you determine annual process  $\text{CO}_2$  emissions using the carbon mass balance procedure in § 98.503(b), you must meet the requirements specified in paragraphs (a) and (b) of this section.

- (a) Determine the annual mass for each material used for the calculations of annual process  $\text{CO}_2$  emissions using equation 1 to § 98.503(b)(1) by summing the monthly mass for the material determined for each month of the calendar year. The monthly mass may be determined using plant instruments used for accounting purposes, including either direct measurement of the quantity of the material placed in the unit or by calculations using process operating information.
- (b) For each material identified in paragraph (a) of this section, you must determine the average carbon content of the material consumed, used, or produced in the calendar year using the methods specified in either paragraph (b)(1) or (2) of this section. If you document that a specific process input or output contributes less than one percent of the total mass of carbon into or out of the process, you do not have to determine the monthly mass or annual carbon content of that input or output.
  - (1) Information provided by your material supplier.
  - (2) Collecting and analyzing at least three representative samples of the material inputs and outputs each year. The carbon content of the material must be analyzed at least annually using the standard methods (and their QA/QC procedures) specified in paragraphs (b)(2)(i) and (ii) of this section, as applicable.
    - (i) ASTM D5373-08 (incorporated by reference, see § 98.7), for analysis of carbonaceous reducing agents and carbon electrodes.
    - (ii) ASTM C25-06 (incorporated by reference, see § 98.7) for analysis of materials such as limestone or dolomite.

### § 98.505 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations in § 98.503 is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter must be used in the calculations as specified in the paragraphs (a) and (b) of this section. You must document and keep records of the procedures used for all such estimates.

- (a) If you determine CO<sub>2</sub> emissions for the calcium carbide process unit at your facility using the carbon mass balance procedure in § 98.503(b), 100 percent data availability is required for the carbon content of the input and output materials. You must repeat the test for average carbon contents of inputs according to the procedures in § 98.504(b) if data are missing.
- (b) For missing records of the monthly mass of carbon-containing inputs and outputs, the substitute data value must be based on the best available estimate of the mass of the inputs and outputs from all available process data or data used for accounting purposes, such as purchase records.

### § 98.506 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (h) of this section, as applicable:

- (a) Annual facility calcium carbide production capacity (tons).
- (b) The annual facility production of calcium carbide (tons).
- (c) Total number of calcium carbide process units at facility used for production of calcium carbide.
- (d) Annual facility consumption of petroleum coke (tons).
- (e) Each end use of any calcium carbide produced and sent off site.
- (f) If the facility produces acetylene on site, provide the information in paragraphs (f)(1) through (3) of this section.
  - (1) The annual production of acetylene at the facility (tons).
  - (2) The annual quantity of calcium carbide used for the production of acetylene at the facility (tons).
  - (3) Each end use of any acetylene produced on-site.
- (g) If a CEMS is used to measure CO<sub>2</sub> emissions, then you must report under this subpart the relevant information required by § 98.36 for the Tier 4 Calculation Methodology and the information specified in paragraphs (g)(1) and (2) of this section.
  - (1) Annual CO<sub>2</sub> emissions (in metric tons) from each CEMS monitoring location measuring process emissions from the calcium carbide process unit.
  - (2) Identification number of each process unit.
- (h) If a CEMS is not used to measure CO<sub>2</sub> process emissions, and the carbon mass balance procedure is used to determine CO<sub>2</sub> emissions according to the requirements in § 98.503(b), then you must report the information specified in paragraphs (h)(1) through (3) of this section.
  - (1) Annual process CO<sub>2</sub> emissions (in metric tons) from each calcium carbide process unit.

- (2) List the method used for the determination of carbon content for each input and output material included in the calculation of annual process CO<sub>2</sub> emissions for each calcium carbide process unit (i.e., supplier provided information, analyses of representative samples you collected).
- (3) If you use the missing data procedures in § 98.505(b), you must report for each calcium carbide production process unit how monthly mass of carbon-containing inputs and outputs with missing data were determined and the number of months the missing data procedures were used.

### § 98.507 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (d) of this section for each calcium carbide process unit, as applicable.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions according to the requirements in § 98.503(a), then you must retain under this subpart the records required for the Tier 4 Calculation Methodology in § 98.37 and the information specified in paragraphs (a)(1) through (3) of this section.
  - (1) Monthly calcium carbide process unit production quantity (tons).
  - (2) Number of calcium carbide processing unit operating hours each month.
  - (3) Number of calcium carbide processing unit operating hours in a calendar year.
- (b) If the carbon mass balance procedure is used to determine CO<sub>2</sub> emissions according to the requirements in § 98.503(b)(2), then you must retain records for the information specified in paragraphs (b)(1) through (5) of this section.
  - (1) Monthly calcium carbide process unit production quantity (tons).
  - (2) Number of calcium carbide process unit operating hours each month.
  - (3) Number of calcium carbide process unit operating hours in a calendar year.
  - (4) Monthly material quantity consumed, used, or produced for each material included for the calculations of annual process CO<sub>2</sub> emissions (tons).
  - (5) Average carbon content determined and records of the supplier provided information or analyses used for the determination for each material included for the calculations of annual process CO<sub>2</sub> emissions.
- (c) You must keep records that include a detailed explanation of how company records of measurements are used to estimate the carbon input and output to each calcium carbide process unit, including documentation of specific input or output materials excluded from equation 1 to § 98.503(b)(1) that contribute less than 1 percent of the total carbon into or out of the process. You also must document the procedures used to ensure the accuracy of the measurements of materials fed, charged, or placed in a calcium carbide process unit including, but not limited to, calibration of weighing equipment and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (d) The applicable verification software records as identified in this paragraph (d). You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (8) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (8) of this section.

- (1) Carbon content in reducing agent (percent by weight, expressed as a decimal fraction) (equation 1 to § 98.503(b)(1)).
- (2) Annual mass of reducing agent fed, charged, or otherwise introduced into the calcium carbide process unit (tons) (equation 1 to § 98.503(b)(1)).
- (3) Carbon content of carbon electrode (percent by weight, expressed as a decimal fraction) (equation 1 to § 98.503(b)(1)).
- (4) Annual mass of carbon electrode consumed in the calcium carbide process unit (tons) (equation 1 to § 98.503(b)(1)).
- (5) Carbon content in product (percent by weight, expressed as a decimal fraction) (equation 1 to § 98.503(b)(1)).
- (6) Annual mass of product produced/tapped in the calcium carbide process unit (tons) (equation 1 to § 98.503(b)(1)).
- (7) Carbon content in non-product outgoing material (percent by weight, expressed as a decimal fraction) (equation 1 to § 98.503(b)(1)).
- (8) Annual mass of non-product outgoing material removed from calcium carbide process unit (tons) (equation 1 to § 98.503(b)(1)).

## § 98.508 Definitions.

All terms used of this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

## Subpart YY—Caprolactam, Glyoxal, and Glyoxylic Acid Production

**Source:** 89 FR 31948, Apr. 25, 2024, unless otherwise noted.

### § 98.510 Definition of the source category.

This source category includes any facility that produces caprolactam, glyoxal, or glyoxylic acid. This source category excludes the production of glyoxal through the LaPorte process (*i.e.*, the gas-phase catalytic oxidation of ethylene glycol with air in the presence of a silver or copper catalyst).

### § 98.511 Reporting threshold.

You must report GHG emissions under this subpart if your facility meets the requirements of either § 98.2(a)(1) or (2) and the definition of source category in § 98.510.

### § 98.512 GHGs to report.

- (a) You must report N<sub>2</sub>O process emissions from the production of caprolactam, glyoxal, and glyoxylic acid as required by this subpart.
- (b) You must report under subpart C of this part the emissions of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O from each stationary combustion unit by following the requirements of subpart C of this part.

## § 98.513 Calculating GHG emissions.

- (a) You must determine annual N<sub>2</sub>O process emissions from each caprolactam, glyoxal, and glyoxylic acid process line using the appropriate default N<sub>2</sub>O generation factor(s) from table 1 to this subpart, the site-specific N<sub>2</sub>O destruction factor(s) for each N<sub>2</sub>O abatement device, and site-specific production data according to paragraphs (b) through (e) of this section.
- (b) You must determine the total annual amount of product *i* (caprolactam, glyoxal, or glyoxylic acid) produced on each process line *t* (metric tons product), according to § 98.514(b).
- (c) If process line *t* exhausts to any N<sub>2</sub>O abatement technology *j*, you must determine the destruction efficiency for each N<sub>2</sub>O abatement technology according to paragraph (c)(1) or (2) of this section.
  - (1) Use the control device manufacturer's specified destruction efficiency.
  - (2) Estimate the destruction efficiency through process knowledge. Examples of information that could constitute process knowledge include calculations based on material balances, process stoichiometry, or previous test results provided the results are still relevant to the current vent stream conditions. You must document how process knowledge (if applicable) was used to determine the destruction efficiency.
- (d) If process line *t* exhausts to any N<sub>2</sub>O abatement technology *j*, you must determine the abatement utilization factor for each N<sub>2</sub>O abatement technology according to paragraph (d)(1) or (2) of this section.
  - (1) If the abatement technology *j* has no downtime during the year, use 1.
  - (2) If the abatement technology *j* was not operational while product *i* was being produced on process line *t*, calculate the abatement utilization factor according to equation 1 to this paragraph (d)(2).

### Equation 1 to paragraph (d)(2)

$$AF_j = \frac{T_{i,j}}{T_i}$$

Where:

$AF_j$  = Monthly abatement utilization factor of N<sub>2</sub>O abatement technology *j* from process unit *t* (fraction of time that abatement technology is operating).

$T_{i,j}$  = Total number of hours during month that product *i* (caprolactam, glyoxal, or glyoxylic acid), was produced from process unit *t* during which N<sub>2</sub>O abatement technology *j* was operational (hours).

$T_i$  = Total number of hours during month that product *i* (caprolactam, glyoxal, or glyoxylic acid), was produced from process unit *t* (hours).

- (e) You must calculate N<sub>2</sub>O emissions for each product *i* from each process line *t* and each N<sub>2</sub>O control technology *j* according to equation 2 to this paragraph (e).

### Equation 2 to paragraph (e)



$$E_{N_2O_t} = \sum_{i,j} \left[ EF_i * P_i * \left( 1 - (DE_j * AF_j) \right) \right] * 0.001$$

Where:

$E_{N_2O_t}$  = Monthly process emissions of  $N_2O$ , metric tons from process line  $t$ .

$EF_i$  =  $N_2O$  generation factor for product  $i$  (caprolactam, glyoxal, or glyoxylic acid), kg  $N_2O$ /metric ton of product produced, as shown in table 1 to this subpart.

$P_i$  = Monthly production of product  $i$ , (caprolactam, glyoxal, or glyoxylic acid), metric tons.

$DE_j$  = Destruction efficiency of  $N_2O$  abatement technology type  $j$ , fraction (decimal fraction of  $N_2O$  removed from vent stream).

$AF_j$  = Monthly abatement utilization factor for  $N_2O$  abatement technology type  $j$ , fraction, calculated using equation 1 to paragraph (d)(2) of this section.

0.001 = Conversion factor from kg to metric tons.

- (f) You must determine the annual emissions combined from each process line at your facility using equation 3 to this paragraph (f):

Equation 3 to paragraph (f)

$$N_2O = \sum_{t=1}^{12} E_{N_2O_t}$$

Where:

$N_2O$  = Annual process  $N_2O$  emissions from each process line for product  $i$  (caprolactam, glyoxal, or glyoxylic acid) (metric tons).

$E_{N_2O_t}$  = Monthly process emissions of  $N_2O$  from each process line for product  $i$  (caprolactam, glyoxal, or glyoxylic acid) (metric tons).

#### § 98.514 Monitoring and QA/QC requirements.

- (a) You must determine the total monthly amount of caprolactam, glyoxal, and glyoxylic acid produced. These monthly amounts are determined according to the methods in paragraph (a)(1) or (2) of this section.
- (1) Direct measurement of production (such as using flow meters, weigh scales, etc.).
  - (2) Existing plant procedures used for accounting purposes (i.e., dedicated tank-level and acid concentration measurements).

- (b) You must determine the annual amount of caprolactam, glyoxal, and glyoxylic acid produced. These annual amounts are determined by summing the respective monthly quantities determined in paragraph (a) of this section.

### § 98.515 Procedures for estimating missing data.

A complete record of all measured parameters used in the GHG emissions calculations is required. Therefore, whenever a quality-assured value of a required parameter is unavailable, a substitute data value for the missing parameter must be used in the calculations as specified in paragraphs (a) and (b) of this section.

- (a) For each missing value of caprolactam, glyoxal, or glyoxylic acid production, the substitute data must be the best available estimate based on all available process data or data used for accounting purposes (such as sales records).
- (b) For missing values related to the N<sub>2</sub>O abatement device, assuming that the operation is generally constant from year to year, the substitute data value should be the most recent quality-assured value.

### § 98.516 Data reporting requirements.

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (j) of this section.

- (a) Process line identification number.
- (b) Annual process N<sub>2</sub>O emissions from each process line according to paragraphs (b)(1) through (3) of this section.
  - (1) N<sub>2</sub>O from caprolactam production (metric tons).
  - (2) N<sub>2</sub>O from glyoxal production (metric tons).
  - (3) N<sub>2</sub>O from glyoxylic acid production (metric tons).
- (c) Annual production quantities from all process lines at the caprolactam, glyoxal, or glyoxylic acid production facility according to paragraphs (c)(1) through (3) of this section.
  - (1) Caprolactam production (metric tons).
  - (2) Glyoxal production (metric tons).
  - (3) Glyoxylic acid production (metric tons).
- (d) Annual production capacity from all process lines at the caprolactam, glyoxal, or glyoxylic acid production facility, as applicable, in paragraphs (d)(1) through (3) of this section.
  - (1) Caprolactam production capacity (metric tons).
  - (2) Glyoxal production capacity (metric tons).
  - (3) Glyoxylic acid production capacity (metric tons).
- (e) Number of process lines at the caprolactam, glyoxal, or glyoxylic acid production facility, by product, in paragraphs (e)(1) through (3) of this section.
  - (1) Total number of process lines producing caprolactam.
  - (2) Total number of process lines producing glyoxal.

- (3) Total number of process lines producing glyoxylic acid.
- (f) Number of operating hours in the calendar year for each process line at the caprolactam, glyoxal, or glyoxylic acid production facility (hours).
- (g) N<sub>2</sub>O abatement technologies used (if applicable) and date of installation of abatement technology at the caprolactam, glyoxal, or glyoxylic acid production facility.
- (h) Monthly abatement utilization factor for each N<sub>2</sub>O abatement technology for each process line at the caprolactam, glyoxal, or glyoxylic acid production facility.
- (i) Number of times in the reporting year that missing data procedures were followed to measure production quantities of caprolactam, glyoxal, or glyoxylic acid (months).
- (j) Annual percent N<sub>2</sub>O emission reduction per chemical produced at the caprolactam, glyoxal, or glyoxylic acid production facility, as applicable, in paragraphs (j)(1) through (3) of this section.
  - (1) Annual percent N<sub>2</sub>O emission reduction for all caprolactam production process lines.
  - (2) Annual percent N<sub>2</sub>O emission reduction for all glyoxal production process lines.
  - (3) Annual percent N<sub>2</sub>O emission reduction for all glyoxylic acid production process lines.

#### **§ 98.517 Records that must be retained.**

In addition to the information required by § 98.3(g), you must retain the records specified in paragraphs (a) through (d) of this section for each caprolactam, glyoxal, or glyoxylic acid production facility:

- (a) Documentation of how accounting procedures were used to estimate production rate.
- (b) Documentation of how process knowledge was used to estimate abatement technology destruction efficiency (if applicable).
- (c) Documentation of the procedures used to ensure the accuracy of the measurements of all reported parameters, including but not limited to, calibration of weighing equipment, flow meters, and other measurement devices. The estimated accuracy of measurements made with these devices must also be recorded, and the technical basis for these estimates must be provided.
- (d) The applicable verification software records as identified in this paragraph (d). You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (4) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (4) of this section.
  - (1) Monthly production quantity of caprolactam from each process line at the caprolactam, glyoxal, or glyoxylic acid production facility (metric tons).
  - (2) Monthly production quantity of glyoxal from each process line at the caprolactam, glyoxal, or glyoxylic acid production facility (metric tons).
  - (3) Monthly production quantity of glyoxylic acid from each process line at the caprolactam, glyoxal, or glyoxylic acid production facility (metric tons).
  - (4) Destruction efficiency of N<sub>2</sub>O abatement technology from each process line, fraction (decimal fraction of N<sub>2</sub>O removed from vent stream).

§ 98.518 Definitions.

All terms used in this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

Table 1 to Subpart YY of Part 98—N<sub>2</sub>O Generation Factors

TABLE 1 TO SUBPART YY OF PART 98—N<sub>2</sub> O GENERATION FACTORS

| Product        | N <sub>2</sub> O generation factor <sup>a</sup> |
|----------------|-------------------------------------------------|
| Caprolactam    | 9.0                                             |
| Glyoxal        | 520                                             |
| Glyoxylic acid | 100                                             |

<sup>a</sup> Generation factors in units of kilograms of N<sub>2</sub> O emitted per metric ton of product produced.

Subpart ZZ—Ceramics Manufacturing

Source: 89 FR 31948, Apr. 25, 2024, unless otherwise noted.

§ 98.520 Definition of the source category.

- (a) The ceramics manufacturing source category consists of any facility that uses nonmetallic, inorganic materials, many of which are clay-based, to produce ceramic products such as bricks and roof tiles, wall and floor tiles, table and ornamental ware (household ceramics), sanitary ware, refractory products, vitrified clay pipes, expanded clay products, inorganic bonded abrasives, and technical ceramics (e.g., aerospace, automotive, electronic, or biomedical applications). For the purposes of this subpart, ceramics manufacturing processes include facilities that annually consume at least 2,000 tons of carbonates, either as raw materials or as a constituent in clay, which is heated to a temperature sufficient to allow the calcination reaction to occur, and operate a ceramics manufacturing process unit.
- (b) A ceramics manufacturing process unit is a kiln, dryer, or oven used to calcine clay or other carbonate-based materials for the production of a ceramics product.

§ 98.521 Reporting threshold.

You must report GHG emissions under this subpart if your facility contains a ceramics manufacturing process and the facility meets the requirements of either § 98.2(a)(1) or (2).

§ 98.522 GHGs to report.

You must report:

- (a) CO<sub>2</sub> process emissions from each ceramics process unit (e.g., kiln, dryer, or oven).

- (b) CO<sub>2</sub> combustion emissions from each ceramics process unit.
- (c) CH<sub>4</sub> and N<sub>2</sub>O combustion emissions from each ceramics process unit. You must calculate and report these emissions under subpart C of this part by following the requirements of subpart C of this part.
- (d) CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O combustion emissions from each stationary fuel combustion unit other than kilns, dryers, or ovens. You must report these emissions under subpart C of this part by following the requirements of subpart C of this part.

### § 98.523 Calculating GHG emissions.

You must calculate and report the annual process CO<sub>2</sub> emissions from each ceramics process unit using the procedures in paragraphs (a) through (c) of this section.

- (a) For each ceramics process unit that meets the conditions specified in § 98.33(b)(4)(ii) or (iii), you must calculate and report under this subpart the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a CEMS to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in § 98.33(a)(4) and all associated requirements for Tier 4 in subpart C of this part.
- (b) For each ceramics process unit that is not subject to the requirements in paragraph (a) of this section, calculate and report the process and combustion CO<sub>2</sub> emissions from the ceramics process unit separately by using the procedures specified in paragraphs (b)(1) through (6) of this section, except as specified in paragraph (c) of this section.
  - (1) For each carbonate-based raw material (including clay) charged to the ceramics process unit, either obtain the mass fractions of any carbonate-based minerals from the supplier of the raw material or by sampling the raw material, or use a default value of 1.0 as the mass fraction for the raw material.
  - (2) Determine the quantity of each carbonate-based raw material charged to the ceramics process unit.
  - (3) Apply the appropriate emission factor for each carbonate-based raw material charged to the ceramics process unit. Table 1 to this subpart provides emission factors based on stoichiometric ratios for carbonate-based minerals.
  - (4) Use equation 1 to this paragraph (b)(4) to calculate process mass emissions of CO<sub>2</sub> for each ceramics process unit:

Equation 1 to paragraph (b)(4)

$$E_{CO_2} = \sum_j \left[ \left( M_j \cdot \frac{2000}{2205} \right) \cdot \sum_i (MF_i \cdot EF_i \cdot F_i) \right]$$

Where:

$E_{CO_2}$  = Annual process CO<sub>2</sub> emissions (metric tons/year).

$M_j$  = Annual mass of the carbonate-based raw material  $j$  consumed (tons/year).

2000/2205 = Conversion factor to convert tons to metric tons.

$MF_i$  = Annual average decimal mass fraction of carbonate-based mineral  $i$  in carbonate-based raw material  $j$ .

$EF_i$  = Emission factor for the carbonate-based mineral  $i$ , (metric tons  $CO_2$ /metric ton carbonate, see table 1 to this subpart).

$F_i$  = Decimal fraction of calcination achieved for carbonate-based mineral  $i$ , assumed to be equal to 1.0.

$i$  = Index for carbonate-based mineral in each carbonate-based raw material.

$j$  = Index for carbonate-based raw material.

- (5) Determine the combined annual process  $CO_2$  emissions from the ceramic process units at your facility using equation 2 to this paragraph (b)(5):

### Equation 2 to paragraph (b)(5)

$$CO_2 = \sum^k_1 E_{CO_2k}$$

Where:

$CO_2$  = Annual process  $CO_2$  emissions from ceramic process units at a facility (metric tons).

$E_{CO_2k}$  = Annual process  $CO_2$  emissions calculated from ceramic process unit  $k$  calculated using equation 1 to paragraph (b)(4) of this section (metric tons).

$k$  = Total number of ceramic process units at facility.

- (6) Calculate and report under subpart C of this part the combustion  $CO_2$  emissions in the ceramics process unit according to the applicable requirements in subpart C of this part.
- (c) A value of 1.0 can be used for the mass fraction ( $MF_i$ ) of carbonate-based mineral  $i$  in each carbonate-based raw material  $j$  in equation 1 to paragraph (b)(4) of this section. The use of 1.0 for the mass fraction assumes that the carbonate-based raw material comprises 100% of one carbonate-based mineral. As an alternative to the default value, you may use data provided by either the raw material supplier or a lab analysis.

### § 98.524 Monitoring and QA/QC requirements.

- (a) You must measure annual amounts of carbonate-based raw materials charged to each ceramics process unit from monthly measurements using plant instruments used for accounting purposes, such as calibrated scales or weigh hoppers. Total annual mass charged to ceramics process units at the facility must be compared to records of raw material purchases for the year.
- (b) You must use the default value of 1.0 for the mass fraction of a carbonate-based mineral, or you may opt to obtain the mass fraction of any carbonate-based materials from the supplier of the raw material or by sampling the raw material. If you opt to obtain the mass fractions of any carbonate-based minerals from the supplier of the raw material or by sampling the raw material, you must measure the carbonate-based mineral mass fractions at least annually to verify the mass fraction data. You may conduct the sampling and chemical analysis using any x-ray fluorescence test, x-ray diffraction test, or other enhanced testing

method published by an industry consensus standards organization (e.g., ASTM, ASME, API). If it is determined that the mass fraction of a carbonate based raw material is below the detection limit of available industry testing standards, you may use a default value of 0.005.

- (c) You must use the default value of 1.0 for the mass fraction of a carbonate-based mineral, or you may opt to obtain the mass fraction of any carbonate-based materials from the supplier of the raw material or by sampling the raw material. If you obtain the mass fractions of any carbonate-based minerals from the supplier of the raw material or by sampling the raw material, you must determine the annual average mass fraction for the carbonate-based mineral in each carbonate-based raw material at least annually by calculating an arithmetic average of the data obtained from raw material suppliers or sampling and chemical analysis.
- (d) You must use the default value of 1.0 for the calcination fraction of a carbonate-based mineral. Alternatively, you may opt to obtain the calcination fraction of any carbonate-based mineral by sampling. If you opt to obtain the calcination fraction of any carbonate-based minerals from sampling, you must determine on an annual basis the calcination fraction for each carbonate-based mineral consumed based on sampling and chemical analysis. You may conduct the sampling and chemical analysis using any x-ray fluorescence test, x-ray diffraction test, or other enhanced testing method published by an industry consensus standards organization (e.g., ASTM, ASME, API).

#### **§ 98.525 Procedures for estimating missing data.**

A complete record of all measured parameters used in the GHG emissions calculations in § 98.523 is required. If the monitoring and quality assurance procedures in § 98.524 cannot be followed and data is unavailable, you must use the most appropriate of the missing data procedures in paragraphs (a) and (b) of this section in the calculations. You must document and keep records of the procedures used for all such missing value estimates.

- (a) If the CEMS approach is used to determine combined process and combustion CO<sub>2</sub> emissions, the missing data procedures in § 98.35 apply.
- (b) For missing data on the monthly amounts of carbonate-based raw materials charged to any ceramics process unit, use the best available estimate(s) of the parameter(s) based on all available process data or data used for accounting purposes, such as purchase records.
- (c) For missing data on the mass fractions of carbonate-based minerals in the carbonate-based raw materials, assume that the mass fraction of a carbonate-based mineral is 1.0, which assumes that one carbonate-based mineral comprises 100 percent of the carbonate-based raw material.

#### **§ 98.526 Data reporting requirements.**

In addition to the information required by § 98.3(c), each annual report must contain the information specified in paragraphs (a) through (c) of this section, as applicable:

- (a) The total number of ceramics process units at the facility and the number of units that operated during the reporting year.
- (b) If a CEMS is used to measure CO<sub>2</sub> emissions from ceramics process units, then you must report under this subpart the relevant information required under § 98.36 for the Tier 4 Calculation Methodology and the following information specified in paragraphs (b)(1) through (3) of this section.
  - (1) The annual quantity of each carbonate-based raw material (including clay) charged to each ceramics process unit and for all units combined (tons).

- (2) Annual quantity of each type of ceramics product manufactured by each ceramics process unit and by all units combined (tons).
- (3) Annual production capacity for each ceramics process unit (tons).
- (c) If a CEMS is not used to measure CO<sub>2</sub> emissions from ceramics process units and process CO<sub>2</sub> emissions are calculated according to the procedures specified in § 98.523(b), then you must report the following information specified in paragraphs (c)(1) through (7) of this section.
  - (1) Annual process emissions of CO<sub>2</sub> (metric tons) for each ceramics process unit and for all units combined.
  - (2) The annual quantity of each carbonate-based raw material (including clay) charged to each ceramics process unit and for all units combined (tons).
  - (3) Results of all tests used to verify each carbonate-based mineral mass fraction for each carbonate-based raw material charged to a ceramics process unit, as specified in paragraphs (c)(3)(i) through (iii) of this section.
    - (i) Date of test.
    - (ii) Method(s) and any variations used in the analyses.
    - (iii) Mass fraction of each sample analyzed.
  - (4) Method used to determine the decimal mass fraction of carbonate-based mineral, unless you used the default value of 1.0 (e.g., supplier provided information, analyses of representative samples you collected, or use of a default value of 0.005 as specified by § 98.524(b)).
  - (5) Annual quantity of each type of ceramics product manufactured by each ceramics process unit and by all units combined (tons).
  - (6) Annual production capacity for each ceramics process unit (tons).
  - (7) If you use the missing data procedures in § 98.525(b), you must report for each applicable ceramics process unit the number of times in the reporting year that missing data procedures were followed to measure monthly quantities of carbonate-based raw materials or mass fraction of the carbonate-based minerals (months).

### § 98.527 Records that must be retained.

In addition to the records required by § 98.3(g), you must retain the records specified in paragraphs (a) through (d) of this section for each ceramics process unit, as applicable.

- (a) If a CEMS is used to measure CO<sub>2</sub> emissions according to the requirements in § 98.523(a), then you must retain under this subpart the records required under § 98.37 for the Tier 4 Calculation Methodology and the information specified in paragraphs (a)(1) and (2) of this section.
  - (1) Monthly ceramics production rate for each ceramics process unit (tons).
  - (2) Monthly amount of each carbonate-based raw material charged to each ceramics process unit (tons).
- (b) If process CO<sub>2</sub> emissions are calculated according to the procedures specified in § 98.523(b), you must retain the records in paragraphs (b)(1) through (6) of this section.



- (1) Monthly ceramics production rate for each ceramics process unit (metric tons).
- (2) Monthly amount of each carbonate-based raw material charged to each ceramics process unit (metric tons).
- (3) Data on carbonate-based mineral mass fractions provided by the raw material supplier for all raw materials consumed annually and included in calculating process emissions in equation 1 to § 98.523(b)(4), if applicable.
- (4) Results of all tests, if applicable, used to verify the carbonate-based mineral mass fraction for each carbonate-based raw material charged to a ceramics process unit, including the data specified in paragraphs (b)(4)(i) through (v) of this section.
  - (i) Date of test.
  - (ii) Method(s), and any variations of methods, used in the analyses.
  - (iii) Mass fraction of each sample analyzed.
  - (iv) Relevant calibration data for the instrument(s) used in the analyses.
  - (v) Name and address of laboratory that conducted the tests.
- (5) Each carbonate-based mineral mass fraction for each carbonate-based raw material, if a value other than 1.0 is used to calculate process mass emissions of CO<sub>2</sub>.
- (6) Number of annual operating hours of each ceramics process unit.
- (c) All other documentation used to support the reported GHG emissions.
- (d) The applicable verification software records as identified in this paragraph (d). You must keep a record of the file generated by the verification software specified in § 98.5(b) for the applicable data specified in paragraphs (d)(1) through (3) of this section. Retention of this file satisfies the recordkeeping requirement for the data in paragraphs (d)(1) through (3) of this section.
  - (1) Annual average decimal mass fraction of each carbonate-based mineral in each carbonate-based raw material for each ceramics process unit (specify the default value, if used, or the value determined according to § 98.524) (percent by weight, expressed as a decimal fraction) (equation 1 to § 98.523(b)(4)).
  - (2) Annual mass of each carbonate-based raw material charged to each ceramics process unit (tons) (equation 1 to § 98.523(b)(4)).
  - (3) Decimal fraction of calcination achieved for each carbonate-based raw material for each ceramics process unit (specify the default value, if used, or the value determined according to § 98.524) (percent by weight, expressed as a decimal fraction) (equation 1 to § 98.523(b)(4)).

## § 98.528 Definitions.

All terms used of this subpart have the same meaning given in the Clean Air Act and subpart A of this part.

**Table 1 to Subpart ZZ of Part 98—CO<sub>2</sub> Emission Factors for Carbonate-Based Raw Materials**

**TABLE 1 TO SUBPART ZZ OF PART 98—CO<sub>2</sub> EMISSION FACTORS FOR CARBONATE-BASED RAW MATERIALS**

| Carbonate                                   | Mineral name(s)                                  | CO <sub>2</sub> emission factor <sup>a</sup> |
|---------------------------------------------|--------------------------------------------------|----------------------------------------------|
| BaCO <sub>3</sub>                           | Witherite, Barium carbonate                      | 0.223                                        |
| CaCO <sub>3</sub>                           | Limestone, Calcium Carbonate, Calcite, Aragonite | 0.440                                        |
| Ca(Fe,Mg,Mn)(CO <sub>3</sub> ) <sub>2</sub> | Ankerite <sup>b</sup>                            | 0.408-0.476                                  |
| CaMg(CO <sub>3</sub> ) <sub>2</sub>         | Dolomite                                         | 0.477                                        |
| FeCO <sub>3</sub>                           | Siderite                                         | 0.380                                        |
| K <sub>2</sub> CO <sub>3</sub>              | Potassium carbonate                              | 0.318                                        |
| Li <sub>2</sub> CO <sub>3</sub>             | Lithium carbonate                                | 0.596                                        |
| MgCO <sub>3</sub>                           | Magnesite                                        | 0.522                                        |
| MnCO <sub>3</sub>                           | Rhodochrosite                                    | 0.383                                        |
| Na <sub>2</sub> CO <sub>3</sub>             | Sodium carbonate, Soda ash                       | 0.415                                        |
| SrCO <sub>3</sub>                           | Strontium carbonate, Strontianite                | 0.298                                        |

<sup>a</sup> Emission factors are in units of metric tons of CO<sub>2</sub> emitted per metric ton of carbonate-based material.

<sup>b</sup> Ankerite emission factors are based on a formula weight range that assumes Fe, Mg, and Mn are present in amounts of at least 1.0 percent.