supplemental fuel. 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) $CO_2$ captured. You must report the mass of $CO_2$ captured under, subpart PP of this part (Suppliers of Carbon Dioxide ($CO_2$) by following the requirements of subpart PP.

### § 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 $CO_2$ 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 combustion of process off-gas to one or more stacks and determine $CO_2$ emissions from each stack (except flare stacks) according to the Tier 4 Calculation Methodology requirements in subpart C of this part. For each stack (except flare stacks) that includes emissions from combustion of petrochemical process off-gas, calculate $CH_4$ and $N_2O$ emissions in accordance with subpart C of this part (use the Tier 3 methodology and emission factors for ''Petroleum'' in Table C–2 of subpart C of this part). For each flare, calculate $CO_2$, $CH_4$, and $N_2O$ emissions using the methodology specified in §98.253(b)(1) through (b)(3).

(c) *Mass balance for each petrochemical process unit.* Calculate the emissions of $CO_2$ 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 carbon content of each sample according to the procedures in §98.244(b)(4). Alternatively, you may use the results of analyses conducted by a fuel or feedstock supplier, provided the sampling and analysis are conducted at least once per month using any of the procedures specified in §98.244(b)(4). If multiple valid carbon content measurements are made during the monthly measurement period, average them arithmetically.

(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 for liquids and solids), then as an alternative to the sampling and analysis specified in paragraph (c)(3) of this section, you may calculate the carbon content assuming 100 percent of that feedstock or product is the specific compound during periods of normal operation. You must maintain records of any determination made in accordance with this paragraph (c)(4) along with all supporting data, calculations, and other information. This alternative may not be used for products during periods of operation when off-specification product is produced. You must re-evaluate determinations made under this paragraph (c)(4) after any process change that affects the feedstock or product composition. You must 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 $CO_2$ 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.

$$C_g = \sum_{n=1}^{12}\left[\sum_{i=1}^{j\ or\ k}\left[\left(F_{gf}\right)_{i,n} * \left(CC_{gf}\right)_{i,n} * \frac{\left(MW_f\right)_i}{MVC} - \left(P_{gp}\right)_{i,n} * \left(CC_{gp}\right)_{i,n} * \frac{\left(MW_p\right)_i}{MVC}\right]\right] \quad \text{(Eq. X-1)}$$

Where:

$C_g$ = Annual net contribution to calculated emissions from carbon (C) in gaseous materials (kilograms/year, kg/yr).

$(F_{gf})_{i,n}$ = Volume of gaseous feedstock i introduced in month ''n'' (standard cubic feet, scf).

$(CC_{gf})_{i,n}$ = Average carbon content of the gaseous feedstock i for month ''n'' (kg C per kg of feedstock).

$(MW_f)_i$ = Molecular weight of gaseous feedstock i (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf per kg-mole at standard conditions).

$(P_{gp})_{i,n}$ = Volume of gaseous product i produced in month ''n'' (scf).

$(CC_{gp})_{i,n}$ = Average carbon content of gaseous product i, including streams containing $CO_2$ recovered for sale or use in another process, for month ''n'' (kg C per kg of product).

$(MW_p)_i$ = Molecular weight of gaseous product i (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.

$$C_l = \sum_{n=1}^{12}\left[\sum_{i=1}^{j\ or\ k}\left[\left(F_{lf}\right)_{i,n} * \left(CC_{lf}\right)_{i,n} - \left(P_{lp}\right)_{i,n} * \left(CC_{lp}\right)_{i,n}\right]\right] \quad \text{(Eq. X-2)}$$

Where:

$C_l$ = Annual net contribution to calculated emissions from carbon in liquid materials, including liquid organic wastes (kg/yr).

$(F_{lf})_{i,n}$ = Volume or mass of liquid feedstock i introduced in month ''n'' (gallons or kg).

$(CC_{lf})_{i,n}$ = Average carbon content of liquid feedstock i for month ''n'' (kg C per gallon or kg of feedstock).

$(P_{lp})_{i,n}$ = Volume or mass of liquid product i produced in month ''n'' (gallons or kg).

$(CC_{lp})_{i,n}$ = 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.

$$C_s = \sum_{n=1}^{12}\left\{\sum_{i=1}^{j\ or\ k}\left[\left(F_{sf}\right)_{i,n} * \left(CC_{sf}\right)_{i,n} - \left(P_{sp}\right)_{i,n} * \left(CC_{sp}\right)_{i,n}\right]\right\} \quad \text{(Eq. X-3)}$$

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 $CO_2$ emissions.

$$CO_2 = 0.001 * \frac{44}{12} * \left(C_g + C_l + C_s\right) \qquad \text{(Eq. X-4)}$$

Where:

$CO_2$ = Annual $CO_2$ 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 $CO_2$ (kg/kg-mole).

12 = Atomic weight of carbon (C) (kg/kg-mole).

(d) *Optional combustion methodology for ethylene production processes.* For any ethylene production process, calculate $CO_2$ emissions from combustion of fuel that contains ethylene process off-gas using the Tier 3 or Tier 4 methodology in subpart C of this part, and calculate $CH_4$ and $N_2O$ emissions using the applicable procedures in §98.33(c) (use the emission factors for ''Petroleum'' in Table C–2 of subpart C of this part (General Stationary Fuel Combustion Sources)). You are not required to use the same Tier for each stationary combustion unit that burns ethylene process off-gas. For each flare, calculate $CO_2$, $CH_4$, and $N_2O$ emissions using the methodology specified in §98.253(b)(1) through (b)(3).

### §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 and maintain 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. Calibrate the measurement device according to the procedures specified by the method, the procedures specified by the manufacturer, or §98.3(i). Recalibrate either biennially or at the minimum frequency specified by the manufacturer.

(2) Operate and maintain all flow meters for gas and liquid feedstocks and products by following the procedures in §98.3(i) and using any of the flow meter methods specified in paragraphs (b)(2)(i) through (b)(2)(xv) of this section, as applicable, use a standard method published by a consensus-based standards organization (e.g., ASTM, API, etc.), or follow procedures specified by the flow meter manufacturer or §98.3(i). Recalibrate each flow meter either biennially or at the minimum frequency specified by the manufacturer.

(i) ASME MFC–3M–2004 Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi (incorporated by reference, *see* §98.7).

(ii) ASME MFC–4M–1986 (Reaffirmed 1997) Measurement of Gas Flow by Turbine Meters (incorporated by reference, *see* §98.7).

(iii) ASME MFC–5M–1985 (Reaffirmed 1994) Measurement of Liquid Flow in Closed Conduits Using Transit-Time Ultrasonic Flowmeters (incorporated by reference, *see* §98.7).