Petroleum Refineries

Subpart Y, Greenhouse Gas Reporting Program

What Must Be Monitored?

For flares, measure these parameters for carbon dioxide (CO_2) emissions:

If you monitor carbon (C) content at least weekly:

- ☐ Volume of flare gas combusted during measurement period (daily or weekly) (standard cubic feet per period (scf/period)).
- ☐ Average molecular weight of flare gas combusted during measurement period (daily or weekly) (kilograms (kg)/kg-mole).
- ☐ Average C content of flare gas combusted during measurement period (daily or weekly) (kg C/kg flare gas).

Or:

- ☐ Volume of flare gas combusted during measurement period (daily or weekly) (scf/period).
- ☐ Mole %CO_2 concentration in the flare gas stream during the measurement period (mole % = % by volume).
- ☐ Mole %concentration of compound “x” in the flare gas stream during the measurement period (mole % = % by volume).

If you monitor heat content at least weekly:

- ☐ Volume of flare gas combusted during measurement period (daily or weekly) (million (MM) scf/period).
- ☐ Higher heating value (HHV) for flare gas during measurement period (daily or weekly) (British thermal units (Btu)/scf = mmBtu/MMscf).

If you do not measure the HHV or C content of the flare gas at least weekly:

- ☐ Annual volume of flare gas combusted during normal operations from company records (MMscf/year (yr)).
- ☐ HHV for fuel gas or flare gas from company records (Btu/scf = mmBtu/MMscf).
- ☐ Number of start-up, shutdown, and malfunction events during the year exceeding 500,000 scf/day.
- ☐ Volume of flare gas combusted during indexed start-up, shutdown, or malfunction event (scf/event).
- ☐ Average molecular weight of the flare gas during indexed start-up, shutdown, or malfunction event (kg/kg-mole).
- ☐ Average C content of flare gas combusted during indexed start-up, shutdown, or malfunction event (kg C/kg flare gas).

For flares, measure these parameters for methane (CH_4) emissions *(Optional):**

- ☐ Weight fraction of C in the flare gas prior to combustion that is contributed by CH_4 from measurement values or engineering calculations (kg C in CH_4 in flare gas/kg C in flare gas) (If not monitored, must use default of 0.4).

Note: *The reporting of CH_4 and nitrous oxide (N_2O) emissions from flares is required. The alternative calculation methods involve the use of default emission factors (EFs) and fuel volumes and do not require* *monitoring beyond what is included on the checklist.*

For catalytic cracking units and traditional fluid coking units with rated capacities greater than 10,000 barrels per stream day (bbls/sd):

For CO_2 emissions:

- ☐ Hourly average %CO_2 concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (% by volume, dry basis).
- ☐ Hourly average %CO concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (% by volume, dry basis). When there is no post-combustion device, assume %carbon monoxide (CO) to be zero.

You must also determine the hourly average exhaust gas flow rate from the fluid catalytic cracking unit regenerator or fluid coking unit burner prior to the combustion of other fossil fuels by monitoring:

- ☐ 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 (dscf/hr)).

Or if using Equation Y-7a:

- ☐ Volumetric flow rate of air to the fluid catalytic cracking unit regenerator or fluid coking unit burner, as determined from control room instrumentation (dscf/hr).
- ☐ Volumetric flow rate of oxygen (O_2) enriched air to the fluid catalytic cracking unit regenerator or fluid coking unit burner, as determined from control room instrumentation (dscf/hr).
- ☐ O_2 concentration in O_2 enriched gas stream inlet to the fluid catalytic cracking unit regenerator or fluid coking unit burner based on O_2 purity specifications of the O_2 supply used for enrichment (% by volume, dry basis).
- ☐ Hourly average %O_2 concentration in exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (% by volume, dry basis).
- ☐ Hourly average %CO_2 concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (% by volume, dry basis).
- ☐ Hourly average %CO concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (% 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.

Or if using Equation Y-7b:

- ☐ Volumetric flow rate of air to the fluid catalytic cracking unit regenerator or fluid coking unit burner, as determined from control room instrumentation (dscf/hr).
- ☐ Volumetric flow rate of O_2 enriched air to the fluid catalytic cracking unit regenerator or fluid coking unit burner, as determined from control room instrumentation (dscf/hr).
- ☐ Nitrogen (N_2) concentration in O_2 enriched gas stream inlet to the fluid catalytic cracking unit regenerator or fluid coking unit burner based on measured value or maximum N_2 impurity specifications of the O_2 supply used for enrichment (% by volume, dry basis).
- ☐ Hourly average %N_2 concentration in the exhaust gas stream from the fluid catalytic cracking unit regenerator or fluid coking unit burner (% by volume, dry basis).

For CH_4 and N_2O emissions:

Calculate emissions using either unit specific measurement data, a unit specific EF based on a source test of the unit, or default values provided in the rule.

If you operate and maintain a continuous emission monitoring system (CEMS) for catalytic cracking units or fluid coking units, in addition to the Tier 4 Calculation Methodology and associated requirements specified in 40 CFR Part 98, Subpart C (General Stationary Fuel Combustion Sources), monitor these parameters if applicable:

Fuel use in the CO boiler or other post-unit combustion device.

If you do not operate a CEMS for catalytic cracking units and traditional fluid coking units with rated capacities of 10,000 bbls/sd or less (if you do not continuously or no less frequently than daily monitor the O_2, CO_2, and, if necessary, CO concentrations in the exhaust stack):

For CO_2 emissions:

- ☐ Annual throughput of unit from company records (bbls/yr).
- ☐ Coke burn-off factor from engineering calculations (kg coke/bbls of feed) (If not monitored, must use default of 7.3 for catalytic cracking units or default of 11 for fluid coking units). *(Optional)**
- ☐ C content of coke based on measurement or engineering estimate (kg C/kg coke) (If not based on measurement or engineering estimate, must use default of 0.94). *(Optional)**

For CH_4 and N_2O emissions:

Calculate emissions using either unit specific measurement data, a unit specific EF based on a source test of the unit, or default values provided in the rule.

If you do not operate a CEMS for fluid coking units that use flexicoking design:

Use methods described in 40 CFR Part 98, Subpart C (General Stationary Combustion Sources) or monitor same parameters for traditional fluid coking units.

If you do not operate a CEMS for catalytic reforming units, but you continuously or no less frequently than daily monitor the O_2, CO_2, and (if necessary) CO concentrations in the exhaust stack from the catalytic reforming unit catalyst regenerator prior to the combustion of other fossil fuels, calculate emissions following the requirements of catalytic cracking units with rated capacities greater than 10,000 bbls/sd; otherwise, measure:

For CO_2 emissions:

- ☐ Coke burn-off quantity per regeneration cycle from engineering estimates (kg coke/cycle).
- ☐ C content of coke based on measurement or engineering estimate (kg C/kg coke). If not based on measurement or engineering estimate, must use default of 0.94. *(Optional)**
- ☐ Number of regeneration cycles in a year.

For CH_4 and N_2O emissions:

Calculate emissions using either unit specific measurement data, a unit specific EF based on a source test of the unit, or default values provided in the rule.

If you operate and maintain a CEMS for sulfur (S) recovery plants, in addition to the Tier 4 Calculation Methodology and associated requirements specified in 40 CFR Part 98, Subpart C (General Stationary Fuel Combustion Sources), monitor:

Fuel use in the Claus burner, tail gas incinerator, or other combustion sources that discharge via the final exhaust stack from the S recovery plan.

If you do not operate a CEMS for on-site S recovery plants and for sour gas sent off-site for S recovery, measure:

For CO_2 emissions:

- ☐ Volumetric flow rate of sour gas feed (including sour water stripper gas) to the S recovery plant, from measurement if available, engineering calculations, or company records (scf/yr).
- ☐ Mole fraction of C in the sour gas to the S recovery plant, from measurement if available or engineering calculations (kg-mole C/kg-mole gas); If not based on measurement or engineering calculations, must use default of 0.20. *(Optional)**

Non-Claus S recovery units may alternatively elect to monitor:

- ☐ Number of venting events per year.
- ☐ Average volumetric flow rate of process gas during the event (scf/hr) (or this may be determined from process knowledge or engineering estimates).
- ☐ Venting time for the event (hrs).
- ☐ Mole fraction of CO_2 in process vent during the event (kg-mol greenhouse gas (GHG)/kg-mol vent gas) (or this may be determined from process knowledge or engineering estimates).

If you operate and maintain a CEMS for coke calcining units, in addition to the Tier 4 Calculation Methodology and associated requirements specified in 40 CFR Part 98, Subpart C (General Stationary Fuel Combustion Sources), monitor:

Fuel use in the coke calcining unit that discharges via the final exhaust stack from the coke calcining unit.

If you do not operate a CEMS for coke calcining units, measure:

For CO_2 emissions:

- ☐ Annual mass of green coke fed to the coke calcining unit from facility records (metric tons/yr).
- ☐ Average mass fraction C content of green coke from facility measurement data (metric tons C/metric tons green coke).
- ☐ Annual mass of marketable petroleum coke produced by coke calcining unit from facility records (metric tons petroleum coke/yr).
- ☐ Annual mass of petroleum coke dust collected in the dust collection system of the coke calcining unit from facility records (metric tons petroleum coke dust/yr).
- ☐ Average mass fraction C content of marketable petroleum coke produced by the coke calcining unit from facility measurement data (metric tons C/metric tons petroleum coke).

For CH_4 and N_2O emissions:

Calculate emissions using either unit specific measurement data, a unit specific EF based on a source test of the unit, or default values provided in the rule.

For uncontrolled asphalt blowing operations or asphalt blowing operations controlled by vapor scrubbing, measure:

The same methods (and thus same parameters measured) to estimate emissions as "Other process vents" can be used. Alternatively, the following parameters can be measured to calculate emissions in conjunction with other emission/conversion factors:

CO_2 emissions:

- ☐ Annual quantity of asphalt blown (MMbbl/yr).
- ☐ EF for CO_2 from uncontrolled asphalt blowing from facility-specific test data (metric tons CO_2/MMbbl asphalt blown); If not based on facility-specific test data must use default of 1,100. *(Optional)**

CH_4 emissions:

- ☐ Annual quantity of asphalt blown (MMbbl/yr).
- ☐ EF for CH_4 from uncontrolled asphalt blowing from facility-specific test data (metric tons CH_4/MMbbl asphalt blown); If not based on facility-specific test data must use default of 580. *(Optional)**

For controlled asphalt blowing operations, measure:

The same methods (and thus same parameters measured) to estimate emissions as "Other process vents" can be used. Alternatively, the following parameters can be measured to calculate emissions in conjunction with other emission/conversion factors:

CO_2 emissions:

- ☐ Annual quantity of asphalt blown (MMbbl/yr).
- ☐ EF for CO_2 from uncontrolled asphalt blowing from facility-specific test data (metric tons CO_2/MMbbl asphalt blown); If not based on facility-specific test data must use a default of 1,100. *(Optional)**
- ☐ C EF from asphalt blowing from facility-specific test data (metric tons C/MMbbl asphalt blown); If not based on facility-specific test data must use a default of 2,750. *(Optional)**

CH_4 emissions:

- ☐ Annual quantity of asphalt blown (MMbbl/yr).
- ☐ EF for CH_4 from uncontrolled asphalt blowing from facility-specific test data (metric tons CH_4/MMbbl asphalt blown); If not based on facility-specific test data must use a default of 580. *(Optional)**

For delayed coking units (DCUs), measure:

For CH_4 emissions:

On December 9, 2016 (81 *FR* 89261), the EPA finalized amendments to the DCU emissions calculation methodology. The new method estimates emissions from DCU using a steam generation model. Key inputs to this heat balance include the mass of water and coke in the coke drum vessel and the average temperature of the coke drum contents when venting first occurs. As an alternative to monitoring the average temperature of the coke drum, the calculation method provides a temperature-pressure correlation. Finally, if a reporter has DCU vent gas measurements, these measurements can be used to develop a unit-specific CH_4 EF for the DCU. These amendments are effective January 1, 2019, for the reporting year 2018 report (which must be submitted by March 31, 2019). Reporters must begin to collect the data necessary to calculate emissions in accordance with the amended method beginning January 1, 2018.

Mass coke in the coke drum vessel:

- ☐ Typical dry mass of coke in the DCU vessel at the end of the coking cycle from company records (metric tons/cycle).

Or:

- ☐ Height of coking unit vessel (feet (ft)).

- ☐ Typical distance from the top of the DCU vessel to the top of the coke bed (i.e., coke drum outage) at the end of the coking cycle (ft) from company records or engineering estimates.
- ☐ Diameter of coking unit vessel (ft).

Mass of water in the coke drum vessel:

- ☐ Diameter of coking unit vessel (ft).
- ☐ 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 (ft) from company records or engineering estimates.

Average temperature of the coke drum vessel:

- ☐ Temperature of the DCU vessel overhead line measured as near the coking unit vessel as practical just prior to venting to the atmosphere. If the temperature of the DCU vessel overhead line is less than 216 Fahrenheit (°F), use a value of 216 °F.
- ☐ Temperature of the DCU vessel near the bottom of the coke bed. If the temperature at the bottom of the coke bed is less than 212 °F, use a value of 212 °F.

Or:

- ☐ Pressure of the DCU vessel just prior to opening the atmospheric vent (pounds per square inch gauge (psig)).

CH_4 emissions calculation:

- ☐ CH_4 EF for DCU (kg CH_4/metric ton steam) from unit-specific measurement data. If you do not have unit-specific measurement data, use the default value of 7.9 kg CH_4/metric tons steam. *(Optional)**
- ☐ Cumulative number of decoking cycles (or coke-cutting cycles) for all DCU vessels associated with the DCU during the year.

For other process vents that exceed the volume percent thresholds provided in the rule, measure these parameters for each GHG:

- ☐ Number of venting events per year.
- ☐ Average volumetric flow rate of process gas during the event (scf/hr) (or this may be determined from process knowledge or engineering estimates). *(Optional)**
- ☐ Venting time for the event (hrs).
- ☐ Mole fraction of each GHG in process vent during the event (kg-mol GHG/kg-mol vent gas) (or this may be determined from process knowledge or engineering estimates). *(Optional)**

For uncontrolled blowdown systems, measure:

The same methods (and thus same parameters measured) to estimate emissions as “Other process vents” can be used. Alternatively, the following parameters can be measured to calculate emissions in conjunction with other emission/conversion factors:

- ☐ Annual quantity of crude oil plus the quantity of intermediate products received from off-site that are processed at the facility (MMbbl/yr).
- ☐ CH_4 EF for uncontrolled blown systems (scf CH_4/MMbbl); If EF is not monitored, must use default of 137,000. *(Optional)**

For equipment leaks, measure:

- ☐ Process-specific CH_4 composition (from measurement data or process knowledge).

Or:

- ☐ Number of atmospheric crude oil distillation columns at the facility.
- ☐ 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.
- ☐ Cumulative number of hydrotreating/hydrorefining units, catalytic reforming units, and visbreaking units at the facility.
- ☐ Number of hydrogen (H_2) plants at the facility.
- ☐ Number of fuel gas systems at the facility.

For storage tanks (other than those processing unstabilized crude oil) that have a vapor-phase CH_4 concentration of 0.5% by volume or more, measure:

- ☐ Tank-specific [liquid-phase] CH_4 composition (from measurement data or product knowledge).

Or:

- ☐ Annual quantity of crude oil plus the quantity of intermediate products received from off-site that are processed at the facility (MMbbl/yr).

For storage tanks that process unstabilized crude oil, measure:

- ☐ Tank-specific [vapor-phase] CH_4 composition (from measurement data or product knowledge).
- ☐ Gas generation rate.

Or:

- ☐ Annual quantity of unstabilized crude oil received at the facility (MMbbl/yr).
- ☐ Pressure differential from the previous storage pressure to atmospheric pressure (psi).
- ☐ Mole fraction of CH_4 in vent gas from the unstabilized crude oil storage tank from facility measurements (kg-mole CH_4/kg-mole gas); default = 0.27 if measurement data are not available. *(Optional)**

For crude oil, intermediate, or product loading operations for which the equilibrium vapor-phase concentration of CH_4 is 0.5% by volume or more, measure:

Product–specific, vapor-phase CH_4 composition (from measurement data or process knowledge).

For More Information

For additional information and resources on Subpart Y, please visit the Subpart Y webpage.

This monitoring checklist is provided solely for informational purposes. It does not replace the need to read and comply with the regulatory text contained in the rule. Rather, it is intended to help reporting facilities and suppliers understand key provisions of the GHGRP. It does not provide legal advice; have a legally binding effect; or expressly or implicitly create, expand, or limit any legal rights, obligations, responsibilities, expectations, or benefits with regard to any person or entity.