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Regulatory Update for Refinery, Petrochemical, and Upstream Flares

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Summary

The United States Environmental Protection Agency (USEPA) continues to update flare regulations for various industries. Although the contents of each regulation varies slightly from rule to rule, each new requirement is intended to ensure flares operate as designed and achieve the desired combustion efficiency. In 2024 alone, new or amended regulations have been published for the upstream oil and natural gas industry, as well as the Synthetic Organic Chemical Manufacturing Industry (SOCMI).

Historical Regulatory Overview

In 2015, the USEPA revised the regulations for petroleum refineries through the Refinery Sector Rule (RSR) revisions to National Emissions Standard for Hazardous Air Pollutants (NESHAP) Subparts CC and UUU (also known as MACT CC and MACT UUU) which added monitoring and control requirements to affected flares. In 2020, the USEPA published revisions to the Ethylene MACT and the Miscellaneous Organics NESHAP (MON) which required affected flares in these industries to comply with the requirements of MACT CC. This pattern continued in 2024 when USEPA published amendments to the Hazardous Organics NESHAP (HON) and several New Source Performance Standards (NSPS) related to SOCMI facilities.

For the upstream oil and natural gas industry, USEPA published several new regulations in 2024 which added additional requirements to flares. NSPS Subparts OOOOb and OOOOc contain similar requirements to the aforementioned downstream regulations. Subpart W of the Greenhouse Gas (GHG) Reporting Program changes the calculation methodology for reporting GHG emissions from flares.

Regulatory Requirements

The rules require facilities with affected flares to meet specific operating limits related to:

1. Pilot/flare flame presence,
2. Visible emissions,
3. Flare tip exit velocity (V_{tip}),

4. Net heating value (NHV) in the combustion zone (NHV_{cz}), and
5. Net heating value dilution parameter (NHV_{dil}) for flares which receive perimeter assist air.

The requirements related to pilot flame presence, visible emissions, and flare tip velocity were previously found in MACT Subpart A[1] and NSPS Subpart A;[2] however, the updated flare regulations include minor modifications to these compliance requirements.

Compliance with the flare operating limits requires monitoring of pilots/flare flame, enhanced visible emissions monitoring, various flow rate monitors, and NHV/composition monitors. These requirements are described in more detail in the following sections.

Pilot/Flare Flame Monitoring

While the requirement to monitor for pilot flame presence was previously included in MACT Subpart A and NSPS Subpart A,[3] the updated regulations expanded the requirement to allow the monitoring of either "the pilot flame or flare flame."[4] The regulatory language below incorporates the allowance from the post-MACT CC rules regarding flare flame into the language from §63.670(b) and §63.670(g). Specifically, the regulations include the requirement to:

> *"operate each flare with a pilot flame or flare flame present at all times when regulated material is routed to the flare. Each 15-minute block during which there is at least one minute where no pilot flame or flare flame is present when regulated material is routed to the flare is a deviation of the standard. Deviations in different 15-minute blocks from the same event are considered separate deviations. The owner or operator shall monitor for the presence of a pilot flame or flare flame as specified in paragraph (g) of this section."* [§63.670(b), as modified by subsequent regulations]

The monitoring requirements are to:

> *"continuously monitor the presence of the pilot flame(s) or flare flame using a device (including, but not limited to, a thermocouple, ultraviolet beam sensor, or infrared sensor) capable of detecting that the pilot flame(s) or flare flame is present."* [§63.670(g), as modified by subsequent regulations]

Pilot/flare flame monitoring is not subject to Table 13 of MACT CC; however, it does have Quality Assurance (QA) requirements found in §63.671.

Visible Emissions Monitoring

The regulations require affected facilities to:

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[1] 40 CFR § 63.11(b)
[2] 40 CFR § 60.18(c)-(f)
[3] 40 CFR § 63.11(b)(5) and 40 CFR § 60.18(c)(2)
[4] 40 CFR § 63.108(b) and 40 CFR § 60.669a(b)

"specify the smokeless design capacity of each flare and operate with no visible emissions, except for periods not to exceed a total of 5 minutes during any 2 consecutive hours, when regulated material is routed to the flare and the flare vent gas flow rate is less than the smokeless design capacity of the flare. The owner or operator shall monitor for visible emissions from the flare as specified in paragraph (h) of this section." [§63.670(c)]

The monitoring requirements are to:

"conduct an initial visible emissions demonstration using an observation period of 2 hours using Method 22 at 40 CFR part 60, appendix A-7. The initial visible emissions demonstration should be conducted the first-time regulated materials are routed to the flare. Subsequent visible emissions observations must be conducted using either the methods in paragraph (h)(1) of this section or, alternatively, the methods in paragraph (h)(2) of this section. The owner or operator must record and report any instances where visible emissions are observed for more than 5 minutes during any 2 consecutive hours as specified in §63.655(g)(11)(ii).

1) *At least once per day for each day regulated material is routed to the flare, conduct visible emissions observations using an observation period of 5 minutes using Method 22 at 40 CFR part 60, appendix A-7. If at any time the owner or operator sees visible emissions while regulated material is routed to the flare, even if the minimum required daily visible emission monitoring has already been performed, the owner or operator shall immediately begin an observation period of 5 minutes using Method 22 at 40 CFR part 60, appendix A-7. If visible emissions are observed for more than one continuous minute during any 5-minute observation period, the observation period using Method 22 at 40 CFR part 60, appendix A-7 must be extended to 2 hours or until 5-minutes of visible emissions are observed. Daily 5-minute Method 22 observations are not required to be conducted for days the flare does not receive any regulated material.*
2) *Use a video surveillance camera to continuously record (at least one frame every 15 seconds with time and date stamps) images of the flare flame and a reasonable distance above the flare flame at an angle suitable for visual emissions observations. The owner or operator must provide real-time video surveillance camera output to the control room or other continuously manned location where the camera images may be viewed at any time."* [§63.670(h)]

The video monitoring option is not included in Table 13 of MACT CC; however, it does have QA requirements found in §63.671.

Flow Rate Monitoring

The regulations require facilities to monitor the flow of vent gas, including supplemental gas addition, and assist gas (steam and/or air) to an affected flare. Additionally:

> *"the flow monitoring systems must be able to correct for the temperature and pressure of the system and output parameters in standard conditions (i.e., a temperature of 20 °C [68 °F] and a pressure of 1 atmosphere)."* [§63.670(i)]

Per §63.670(i)(2), mass flow meters may be used for monitoring the flow of gas, but the measurements must be converted to volumetric flow using Equation (1) shown below:

$$Q_{vol} = \frac{Q_{mass} \times 385.3}{MWt} \quad (1)$$

Where:

Q_{vol} = Volumetric flow rate (standard cubic feet per second [scf/s])
Q_{mass} = Mass flow rate (pounds per second [lb/s])
385.3 = Molar volume at the required standard conditions (standard cubic feet per pound-mole [scf/lb-mol])
MWt = Molecular weight of the gas (pounds per pound-mole [lb/lb-mol])

Additionally:

> *"[the] monitoring equipment must meet the applicable minimum accuracy, calibration and quality control requirements specified in table 13 of this subpart."* [§63.671(a)(1)]

And:

> *"the Continuous Parameter Monitoring System (CPMS) must be capable of measuring the appropriate parameter over the range of values expected for that measurement location."* [§63.671(a)(8)]

Vent Gas Flow Monitoring

In order to be able to determine compliance with the operating limits, the vent gas flow rate is required to be continuously monitored, as described below. The volumetric flow rate must be cumulative over each 15-minute block period and only needs to include flow during periods when regulated material is sent to the flare. Including all flows during the 15-minute block period is also allowed under the Rule. The post-MACT CC regulations further clarify this point by stating:

> *"When determining compliance with the flare tip velocity and combustion zone operating limits specified in §63.670(d) and (e) of [subpart CC of this part/part 63, subpart CC of this chapter], the requirement effectively applies starting with the 15-minute block that includes a full 15 minutes of the flaring event. [The owner or operator is/You are] required to demonstrate compliance with the velocity and NHV_{cz} requirements starting with the block that contains the fifteenth minute of a flaring event. [The owner or operator is/You are] not required to demonstrate compliance for the previous 15-minute block in which the event started and contained only a fraction of flow."* [§63.108(c)]

Flare vent gas is defined as:

> *"all gas found just prior to the flare tip. This gas includes all waste gas, that portion of sweep gas that is not recovered, purge gas, and supplemental gas but does not include pilot gas, total steam or assist air."* [§63.641]

If a mass flow meter is used, the readings must be converted to a volumetric basis according Equation (1) using the molecular weight (MW) determined by compositional analysis.

Table 13 of MACT CC specifies the minimum accuracy and calibration requirements for vent gas flow meters.

Parameter	**Minimum Accuracy Requirements**	**Calibration Requirements**
Flare Vent Gas Flow Rate	• ±20 percent of flow rate at velocities ranging from 0.03 to 0.3 meters per second (0.1 to 1 feet per second) • ±5 percent of flow rate at velocities greater than 0.3 meters per second (1 feet per second)	• Conduct a flow sensor calibration check at least biennially (every two years); conduct a calibration check following any period of more than 24 hours throughout which the flow rate exceeded the manufacturer's specified maximum rated flow rate or install a new flow sensor. • At least quarterly, inspect all components for leakage, unless the CPMS has a redundant flow sensor. • Record the results of each calibration check and inspection. • Locate the flow sensor(s) and other necessary equipment (such as straightening vanes) in a position that provides representative flow; reduce swirling flow or abnormal velocity distributions due to upstream and downstream disturbances.

Assist Gas Flow Monitoring

Assist gas can be either steam or air. For steam-assisted flares, the total volumetric flow of steam, which could include center, lower, and upper steam, supplied to the flare must be monitored. Mass flow meters or engineering calculations with continuous temperature and pressure monitoring are allowed in place of directly measuring the volumetric flow of steam. For air-assisted flares, flow may either be directly monitored or determined using a fan curve for the blower which supplies the assist air.

Parameter	Minimum Accuracy Requirements	Calibration Requirements
Flow Rate for All Flows Other Than Flare Vent Gas	• ±5 percent over the normal range of flow measured or 280 liters per minute (10 cubic feet per minute), whichever is greater, for gas flow • ±5 percent over the normal range measured for mass flow	• Conduct a flow sensor calibration check at least biennially (every two years); conduct a calibration check following any period of more than 24 hours throughout which the flow rate exceeded the manufacturer's specified maximum rated flow rate or install a new flow sensor. • At least quarterly, inspect all components for leakage, unless the CPMS has a redundant flow sensor. • Record the results of each calibration check and inspection. • Locate the flow sensor(s) and other necessary equipment (such as straightening vanes) in a position that provides representative flow; reduce swirling flow or abnormal velocity distributions due to upstream and downstream disturbances.

Supplemental Gas Flow Monitoring

Monitoring the flow of supplemental gas for compliance demonstration is dependent on the point of injection and the calculation method chosen for compliance. If the supplemental gas is introduced downstream of the vent gas flow meter and/or the NHV monitoring system or if the feed forward compliance calculation method is chosen, then a supplemental gas flow meter is required to demonstrate compliance.

Based on the definition of vent gas, supplemental gas is a part of flare vent gas. Therefore, if a separate supplemental gas flow meter is necessary to demonstrate compliance, the flow meter must meet the accuracy and QA requirements of a vent gas flow meter. If a mass flow meter is used, the MW of the supplied natural gas will need to be determined to assess if a constant value can be utilized in Equation (1).

Vent Gas NHV/Composition Monitoring

The rules require affected facilities to monitor either the vent gas composition or the net heating value in the vent gas (NHV_{vg}) for each affected flare [§63.670(j)]. The regulations allow several options for complying with this requirement.

1. Install a monitoring system capable of continuously (i.e., at least once every 15 minutes) monitoring the concentration of each individual component of the vent gas;
2. Install a grab sampling system capable of collecting a sample at least once every eight (8) hours;
3. Install a monitoring system capable of directly measuring NHV_{vg} (with the option of additionally measuring the concentration of hydrogen); or
4. Apply for an exemption using the results of sampling a gas stream and demonstrating a consistent or fixed minimum NHV_{vg}.

If the composition of the vent gas is monitored per Option 1, the concentrations of each vent gas constituent will be used to calculate NHV_{vg} using Equation (2) below:

$$NHV_{vg} = \sum_{i=1}^{n} x_i \times NHV_i \qquad (2)$$

Where:

i = Individual component in flare vent gas
n = Number of components in flare vent gas
x_i = Concentration of component i in flare vent gas (volume fraction)
NHV_i = Net heating value of component i as shown in Table 12 of the Rule (British thermal units per standard cubic foot [Btu/scf])

If the grab sample option is selected, the regulations specify the following procedure for determining which grab sample is to be used for demonstrating compliance.

i. *Use the analytical results from the first grab sample collected for an event for all 15-minute periods from the start of the event through the 15-minute block prior to the 15-minute block in which a subsequent grab sample is collected.* [§63.670(l)(6)(i)]

ii. *Use the results from subsequent grab sampling events for all 15-minute periods starting with the 15-minute block in which the sample was collected and ending with the 15-minute block prior to the 15-minute block in which the next grab sample is collected. For the purpose of this requirement, use the time the sample was collected rather than the time the analytical results become available.* [§63.670(l)(6)(ii)]

If an affected plant chooses to install a monitoring system capable of directly measuring NHV_{vg} (i.e., a calorimeter), the regulations also allow for the use of a second instrument to measure hydrogen. The regulations allow plants to use an effective NHV of hydrogen of 1,212 Btu/scf, instead of its actual NHV of 274 Btu/scf, if the concentration of hydrogen is continuously monitored. If this option is used, the hydrogen concentration will need to be updated each time

that the hydrogen instrument completes a cycle (at least once every 15 minutes). That value will be used to correct the measured NHV_{vg} from the calorimeter until the next hydrogen measurement is reported. The measurement from the calorimeter can be adjusted, based on the concentration of hydrogen in the vent gas, as shown below in Equation (3).

$$NHV_{vg} = NHV_{measured} + 938x_{H_2} \quad (3)$$

Where:

$NHV_{measured}$ = NHV_{vg} as measured by the calorimeter (Btu/scf)

x_{H_2} = Concentration of hydrogen in flare vent gas at the time the sample was input into the net heating value monitoring system (volume fraction)

938 = Net correction for the measured heating value of hydrogen (Btu/scf)

Direct compositional or NHV monitoring is not required for flares with demonstrated consistent composition or minimum NHV_{vg}. In order to qualify for the exemption, plants are required to document the conditions which allow the flare to qualify for the exemption and obtain a minimum of 14 daily grab samples which support the assertion that the vent gas maintains a constant or minimum NHV_{vg}. For infrequently operated flare gas streams/systems, seven grab samples must be collected unless other additional information would support reduced sampling.

Table 13 of MACT CC specifies the minimum accuracy and calibration requirements for instrumentation used to monitor either NHV_{vg} or the vent gas composition.

Parameter	Minimum Accuracy Requirements	Calibration Requirements
Net Heating Value by Calorimeter	• ±2 percent of span	• Specify calibration requirements in your site specific CPMS monitoring plan. Calibration requirements should follow manufacturer's recommendations at a minimum. • Temperature control (heated and/or cooled as necessary) the sampling system to ensure proper year-round operation. • Where feasible, select a sampling location at least two equivalent diameters downstream from and 0.5 equivalent diameters upstream from the nearest disturbance. Select the sampling location at least two equivalent duct diameters from the nearest control device, point of pollutant generation, air in-leakages, or other point at which a change in the pollutant concentration or emission rate occurs.
Net Heating Value by Gas Chromatograph or Mass Spectrometer	• As specified in Performance Specification 9 of 40 CFR part 60, appendix B	• Follow the procedure in Performance Specification 9 of 40 CFR part 60, appendix B, except that a single daily mid-level calibration check can be used (rather than triplicate analysis), the multi-point calibration can be conducted quarterly (rather than monthly), and the sampling line temperature must be maintained at a minimum temperature of 60 °C (rather than 120 °C).

Flare Tip Exit Velocity

The regulations require facilities to:

> *"comply with either paragraph (d)(1) or (2) of this section, provided the appropriate monitoring systems are in-place, whenever regulated material is routed to the flare for at least 15-minutes […]*
>
> 1) *Except as provided in paragraph (d)(2) of this section, the actual flare tip velocity (V_{tip}) must be less than 60 feet per second. The owner or operator shall monitor V_{tip} using the procedures specified in paragraphs (i) and (k) of this section.*

2) *V_{tip} must be less than 400 feet per second and also less than the maximum allowed flare tip velocity (V_{max}) as calculated according to the following equation. The owner or operator shall monitor V_{tip} using the procedures specified in paragraphs (i) and (k) of this section and monitor gas composition and determine NHV_{vg} using the procedures specified in paragraphs (j) and (l)*[...]*"* [§63.670(d)]

$$\log_{10}(V_{max}) = \frac{NHV_{vg} + 1{,}212}{850} \quad (4)$$

Where:

V_{max} = Maximum flare tip velocity (ft/s)
NHV_{vg} = Net heating value of the vent gas (Btu/scf)
1,212 = Constant
850 = Constant

Owners and operators of flares were required to comply with similar requirements under MACT Subpart A and NSPS Subpart A;[5] however, the equation by which V_{max} is determined has been converted to English units.

Using the vent gas flow and unobstructed cross-sectional area of the flare tip, V_{tip} may be calculated using Equation (5) below:

$$V_{tip} = \frac{Q_{cum}}{Area \times 900} \quad (5)$$

Where:

V_{tip} = Flare tip velocity (ft/s)
Q_{cum} = Cumulative volumetric flow over 15-minute block average period (scf)
Area = Unobstructed area of the flare tip (square feet)
900 = Conversion factor (seconds per 15-minute block average)

Net Heating Value – Combustion Zone

The regulations establish an operating limit of 270 Btu/scf for the NHV_{cz} [§63.670(e)] for non-pressure assisted flares. NHV_{cz} represents the concept that assist gas in the combustion zone dilutes the combustible material and reduces the destruction removal efficiency (DRE) of the flare. The NHV_{cz} limit applies to all flares subject to one or more of the revised flare rules. Compliance is determined on a 15-minute block average basis when regulated material is sent to the flare for at least 15 minutes.[6]

Previous flare regulations (MACT Subpart A and NSPS Subpart A) included the requirement that steam and air-assisted flares maintain a minimum NHV_{vg} of 300 Btu/scf. Unassisted flares were subject to lower NHV_{vg} limit of 200 Btu/scf. Once a flare complies with the §63.670 and

[5] 40 CFR § 63.11(b)(7) and 40 CFR § 60.18(f)(5)
[6] 40 CFR § 63.108(c) and 40 CFR § 60.669a(c)

§63.671 requirements, it is no longer required to comply with the MACT or NSPS Subpart A requirements:

> *"For any flare that is used to reduce organic HAP emissions from a chemical manufacturing process unit, the owner or operator may elect to comply with the requirements in this section in lieu of the requirements of §63.11(b) of subpart A of this part and the requirements referenced therein. The owner or operator may also elect to comply with the requirements in this section pursuant to the overlap provisions provided in §63.110(j) of subpart G of this part. However, for each source as defined in §63.101 and for each source as defined in §63.191 of subpart I of this part, beginning no later than the compliance dates specified in §63.100(k)(10), the provisions specified in paragraphs (a)(1) through (a)(22) of this section no longer apply. Instead, if an owner or operator reduces organic HAP emissions from a chemical manufacturing process unit by venting emissions through a closed-vent system to a steam-assisted, air-assisted, non-assisted, or pressure-assisted multi-point flare, then the owner or operator must meet the applicable requirements for flares as specified in §§63.670 and 63.671 of subpart CC of this part, including the provisions in Tables 12 and 13 to subpart CC of this part, except as specified in paragraphs (b) through (o) of this section."* [§63.108(a)]

Therefore, a flare which complies with the flare requirements of one of the revised flare rules, it does not need to comply with MACT Subpart A and NSPS Subpart A.

Net Heating Value – Dilution Parameter

In addition to the NHV_{cz}, flares actively receiving perimeter assist air are subject to the NHV_{dil} limit [§63.670(f)], which must be greater than or equal to 22 British thermal units per square foot (Btu/ft^2) on a 15-minute block average basis when regulated material is sent to the flare for at least 15 minutes. This parameter primarily focuses on the time vent gas spends in the flammability region above the flare tip (i.e., the combustion zone).

The RSR defines assist air as

> *"all air that intentionally is introduced prior to or at a flare tip through nozzles or other hardware conveyance for the purposes including, but not limited to, protecting the design of the flare tip, promoting turbulence for mixing or inducing air into the flame. Assist air includes premix assist air and perimeter assist air. Assist air does not include the surrounding ambient air."* [§63.641]

The RSR defines perimeter assist air as

> *"the portion of assist air introduced at the perimeter of the flare tip or above the flaretip. Perimeter assist air includes air intentionally entrained in lower and upper steam. Perimeter assist air includes all assist air except premix assist air."* [§63.641]

Similar to NHV_{cz}, the NHV_{vg} operating limits found in NSPS and MACT Subpart A do not apply to flares complying with the NHV_{dil} limit.

Pressure-Assisted Multi-Point Ground Flares

Beginning with the amendments to the EMACT [§63.1103(e)(4)(vi)], the revised flare rules have included provisions related to pressure-assisted multi-point ground flares (MPGF). These flares are designed to operate with V_{tip} in excess of the limits described earlier in this paper. The USEPA has previously approved the use of these flares through Alternative Means of Emissions Limitation (AMEL) requests submitted by the operating company.

The MPGF amendments establish the following:

- MPGF are not subject to the V_{tip} requirements in §63.670(d) and §63.670(k);
- MPGF must maintain a NHV_{cz} of 800 Btu/scf;
- Each stage in a MPGF must have at least two continuously lit pilot flames;
- Burners within a stage must be spaced within a maximum cross-lighting distance of six feet.

Key Differences in NSPS OOOOb

NSPS Subpart OOOOb contains requirements similar to MACT CC and its related rules but with a number of differences in compliance thresholds, monitoring instrumentation requirements, and the possibility for exemption from monitoring requirements.

Compliance Thresholds

The NHV_{cz}, NHV_{dil}, and pressure-assisted flare NHV_{cz} requirements established in the RSR are shared by NSPS OOOOb; however, the rule maintains the NHV_{vg} threshold for unassisted flares from NSPS and MACT Subpart A:

> *"For unassisted flares, you must maintain the NHV of the vent gas sent to the flare at or above 200 Btu/scf."* [§60.5412b(a)(3)(i)]

Additionally, NSPS OOOOb establishes a minimum vent gas flow rate threshold for each affected flare:

> *"You must operate the flare at or above the minimum inlet gas flow rate. The minimum inlet gas flow rate is established based on manufacturer recommendations."* [§60.5412b(a)(3)(vi)]

Pilot/Flare Flame Monitoring

The NSPS OOOOb pilot flame requirements are less specific than the requirements found in the RSR. The requirements are to:

> *"install and operate a continuous burning pilot or combustion flame. An alert must be sent to the nearest control room whenever the pilot or combustion flame is unlit."* [§60.5412b(a)(3)(viii)]

The monitoring requirements are to:

> *"Continuous parameter monitoring systems used to detect the presence of a pilot or combustion flame must record a reading at least once every 5 minutes."* [§60.5417b(c)(1)]

Pilot monitors are exempted from the QA requirements of the rule.

Visible Emissions Monitoring

NSPS OOOOb requires affected flares to operate with no visible emissions, as determined via Method 22 observation or video monitoring.[7] An exceedance is defined as one minute of visible emissions in a 15-minute period, rather than five minutes in a two-hour period, and Method 22 observations must be conducted on a monthly basis.

If the video camera observation method is selected, the following monitoring requirements must be met:

> *"(1) You must provide real-time high-definition video surveillance camera output (i.e., at least 720p) at a frame rate of at least 15 frames per second to the control room or other continuously manned location where the camera images may be viewed at the same resolution at any time.*
>
> *(2) You must record at least one frame every 15 seconds with date and time stamp.*
>
> *(3) The camera must be located at a reasonable distance above the flare flame at an angle suitable for visual emissions observations. The position of the camera should be such that the sun is not in the field of view.*
>
> *(4) The camera must be located no more than 400 m (0.25 miles) from the emission source.*
>
> *(5) Operators must look at the video feed at least once daily for an observation period of at least 1 minute to determine if visible emissions are present. If visible emissions are present during a daily observation, the operator must observe the video feed for 15 minutes or until the amount of time visible emissions is present has exceeded 1 minute, whichever time period is less."* [§60.5417b(h)]

Continuous Parameter Monitoring Systems

CPMS installed to monitor vent gas flow, assist gas flow, or composition must measure values at least once every hour,[8] and a three-hour rolling average must be constructed for each operating parameter.[9] Steam and air-assisted flares must also evaluate NHV_{cz} and NHV_{dil}, as applicable, on a 15-minute block basis.

[7] 40 CFR § 60.5412b(a)(1)(ix)
[8] 40 CFR 60.5417b(c)(1)
[9] 40 CFR 60.5417b(e)(5)

Unlike the RSR's generic options, NSPS OOOOb identifies four allowed monitoring technologies for NHV/composition monitoring:

1. Calorimeter;
2. Gas Chromatograph;
3. Mass Spectrometer; or
4. Grab Samples on an eight-hour frequency.

Monitoring Exemptions

NSPS OOOOb provides a pathway to exemption from vent gas flow and NHV/composition monitoring for unassisted, pressure-assisted, and air-assisted flares.

In order to obtain a vent gas flow monitoring exemption, the flare must have a back-pressure regulator installed which opens at the flare's minimum flow rate and demonstrate that, regardless of operating conditions, the following limits cannot be exceeded.[10]

Flare Type	Limit
Pressure-Assisted	Operates with this exemption by default
Unassisted	$V_{tip} \leq 60$ ft/s
Air-Assisted	$NHV_{dil} \geq 22$ Btu/ft^2
Steam-Assisted	N/A; Steam-assisted flares cannot qualify for this exemption

Each earned flow monitoring exemption is valid until changes are made to the process or flare which could impact the maximum flow rate, at which point the demonstration must be successfully repeated to maintain the exemption.

Flares at which all vent gas is associated gas from well affected facilities qualify for a NHV/composition monitoring exemption. Otherwise, in order to obtain an NHV/composition monitoring exemption, the facility must perform one of the following demonstrations:

1. Continuously monitor the NHV/composition of the vent gas over 14 consecutive operating days;
2. Collect and analyze twice daily samples over 14 consecutive operating days; or
3. Continuously measure the combustion efficiency of the flare over 14 consecutive operating days (unassisted and pressure-assisted flares only).

In order to qualify for the exemption when testing according to option one, none of the hourly samples may have an NHV below the limit in the following table. If testing according to option two, none of the samples may have an NHV below 1.2 times the limit in the table.

[10] 40 CFR 60.5417b(d)(8)(iv)(A)-(E)

Flares being tested using option three must have zero measurements below 95% combustion efficiency.[11]

Assist Type	NHV_{vg} Limit (Btu/scf)	1.2x NHV_{vg} Limit (Btu/scf)
Unassisted	200	240
Pressure-Assisted	800	960
Assist Air	300	360

The demonstration must be repeated any time process operations changes that could impact the NHV of the vent gas occur. Exemptions are valid for five years, at which time three samples must be obtained and tested. The exemption is maintained if all three samples have an NHV greater than 1.2 times the applicable limit.

Changes to GHG Reporting Program Subpart W

Subpart W of the GHG Reporting Program establishes calculation methodologies for methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) emissions from flares. The amendments to the rule update Equation W-19 to incorporate flare destruction removal efficiency, while Equations W-20 and W-40 remain unchanged.

$$E_{s,CH_4} = V_s \times X_{CH_4} \times [(1 - \eta_D) \times Z_L + Z_U]$$

Eq. W-19

Where:

$E_{s,CH4}$ = Annual CH_4 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
η_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_2
X_{CH4} = Annual average mole fraction of CH_4 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 $1 - Z_U$).

[11] 40 CFR 60.5417b(d)(8)(iii)

Efficiency Tiers

The amendments to Subpart W establish three tiers of Destruction Removal Efficiency (DRE) and Combustion Efficiency (CE) for use in Equation W-19.

Tier	DRE (%)	CE (%)	Requirements
Tier 1	98	96.5	Comply with the flare requirements of MACT CC
Tier 2	95	93.5	Comply with the flare requirements of NSPS OOOOb
Tier 3	92	90.5	Not compliant with either MACT CC or NSPS OOOOb

Facilities assume the DRE and CE for a flare, based on the tier for which it qualifies. Failure to adhere to a chosen tier's requirements for 15 or more consecutive days will move the flare to Tier 3 until those requirements are again met.[12]

Pilot Monitoring

The pilot monitoring requirements of the Subpart W amendments are to:

> *"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.*

[12] 40 CFR 98.233(n)(1)

> *(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."* [§98.233(n)(2)(i)]

If the affected flare is a Tier 3 flare, continuous monitoring may be replaced with monthly visual inspections for the presence of a pilot flame or combustion flame. If a flame is not detected during a visual inspection, the time between the failed inspection and previous inspection is treated as a period without a lit pilot flame.[13]

Flow Monitoring

The amendments to Subpart W allow vent gas flow to be determined by a variety of methods:[14]

1. Use a CPMS to measure the flow of gas to the flare downstream of all vent gas additions at least once per hour;
2. Calculate flow at least once per hour using other parameter monitoring systems combined with engineering calculations; or
3. Determine flow to the flare on a source-by-source basis, using CPMS or the calculation methods presented in 40 CFR 98.233(n)(3)(ii)(B)(*1*)-(*8*).

Additionally, pilot gas flow must be determined using engineering calculations and best available data and added to the total vent gas flow. The total annual flow of vent gas must be calculated using the flow data gathered.

[13] 40 CFR 98.233(n)(2)(ii)
[14] 40 CFR 98.233(n)(3)

Composition Monitoring

Where the RSR and NSPS OOOOb allow either the NHV or composition of the vent gas stream to be determined to demonstrate compliance with the regulation, the amendments to Subpart W require the composition of the vent gas stream to be determined to perform the calculations in Equations W-19 and W-20. The amendments to Subpart W allow vent gas composition to be determined by a variety of methods:[15]

1. Use a CPMS to measure the composition of the vent gas downstream of all vent gas additions at least once per hour;
2. Take vent gas samples at least annually and analyze the composition of the gas.
3. Use a CPMS to measure the composition of, or use the calculation methods presented in 40 CFR 98.233(n)(4)(iii)(B)(*1*)-(*7*), each composite stream which makes up the vent gas.

Conclusions

The USEPA will continue to expand the breadth and scope of the current generation of flare regulations. While the updates to the HON mirror those seen in previous rules, NSPS OOOOb and GHG Reporting Program Subpart W show a willingness to adjust the requirements to suit the regulated industry.

[15] 40 CFR 98.233(n)(4)