

Standardized Nomenclature for Natural Gas Transmission and Storage Greenhouse Gas Emissions

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Abstract

Different nomenclature is commonly used to describe similar natural gas industry equipment and operations. To facilitate communication, ensure data consistency, and promote data transfer efficiency, all greenhouse gas (GHG) emission estimation methods users should have the same base understanding of all natural gas industry equipment and operations that emit GHGs. This report attempts to:

- define standard industry boundaries - natural gas industry borders (e.g. with oil production) and sector borders (e.g. production, processing, transmission and storage, distribution, and LNG) including common multi-use facility issues; and
- provide standardized sector-specific emission source nomenclature - i.e. naming conventions, descriptions, figures, and diagrams that improve the fidelity of sector-specific GHG emissions reporting.

Keywords

Greenhouse gas (GHG), GHG nomenclature, GHG definitions, GHG terminology, standard industry boundaries, natural gas sector GHG sources, GHG mandatory reporting rule, GHG inventories.

Value to Members

The primary objective of this report is to standardize nomenclature used in the estimation and reporting of greenhouse gas emissions and provide a single living document to be used as a reference to enhance consistency within the natural gas industry. This document may also serve to form a more accurate basis for consistent reporting of emission sources through an enhanced common understanding of industry and regulatory terminology, synonyms and sector boundaries. Consistent terminology will promote higher fidelity emission inventories and focus subsequent EPA control strategies and requirements.

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1.0 Introduction

This technical report provides a compilation of harmonized terminology and standardized nomenclature for natural gas transmission and storage (T&S) equipment and operations associated with greenhouse gas (GHG) emission sources and emission estimates. Criteria for natural gas industry “segment” borders (per segments in 40 CFR 98) for GHG inventories are also addressed. This “living document” is intended to be a detailed reference for practitioners and managers developing GHG inventories. The document’s primary purpose is to support T&S facilities GHG emissions reporting for 40 CFR 98 “Mandatory Greenhouse Gas Reporting”; however, information is also provided to support the development of GHG emission inventories for other purposes. As photographs or additional figures are obtained, periodic updates may be completed to provide additional clarity and term distinction.

Varied nomenclature and naming conventions have historically been used to describe similar natural gas industry equipment and operations that emit GHGs. Nomenclature can vary from company-to-company and within different operating units of the same company. EPA definitions and terminology are also varied among the many air regulations, the GHG reporting rule and even within EPA’s Natural Gas STAR program. This document is intended to facilitate communication by: promoting data consistency, comparability, and transfer efficiency (e.g., roll up); and, providing a common basis for understanding natural gas T&S GHG emissions-related equipment and operations. To achieve this goal, the objectives of this report are to:

- Provide EPA definitions to assist users in defining consistent, standard natural gas industry borders (e.g., with oil production) and segment borders (e.g., production, processing, transmission and storage, distribution, and LNG) including common multi-use facility issues; and
- Provide standardized segment-specific emission source nomenclature – i.e., naming conventions and descriptions of GHG emission sources, and associated equipment and operations.

Section 2 of this report includes background information including discussion of greenhouse gases, GHG emission source categories and emission estimation methods, and emission inventory programs and regulations. Section 3 provides standard natural gas industry and segment borders for T&S for GHG emission estimates. Additional descriptions of sector borders for other industry segments are provided in Appendix A. Section 4 provides nomenclature for natural gas T&S segment GHG emission sources and associated equipment and operations. Applicable definitions and descriptions from 40 CFR 98 “Mandatory Greenhouse Gas Reporting” are included; for some of these definitions, alternative definitions or descriptions are also included to provide additional detail and clarity. Section 5 lists references.

2.0 Background

2.1 Greenhouse Gases

A number of gases are typically considered as GHGs, including carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons (e.g., C_nF_{2n+2} compounds), and sulfur hexafluoride. For emissions from oil and natural gas systems, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are the most significant species contributing to the total GHG inventory and most commonly reported.

Different GHGs have different capacity to trap atmospheric heat. Global Warming Potential (GWP) is an index that has been developed to compare different GHGs on a common reporting basis. CO_2 is used as the reference gas and the GWP of another GHG compares the ability of that gas (on a mass basis) to trap atmospheric heat relative to CO_2 . Thus, GHG emissions are commonly reported as CO_2 equivalents [e.g., tonnes of equivalent (CO_2e), where a tonne is a metric ton or 1,000 kg]. Comparing GWPs is useful because GWP takes into account both the warming potential of each molecule of a gas, and its atmospheric lifetime (how long it remains in the atmosphere).

New GWP values continue to advance as the state-of-the-science improves and newer data and research improve upon the estimates of radiative forcing impacts. Table 2-1 summarizes GWPs from the last three Intergovernmental Panel on Climate Change (IPCC) assessment reports. Table A-1 of 40 CFR 98 Subpart A and §98.233(v) of 40 CFR 98 Subpart W specifies the use of the SAR GWP values. This is consistent with international reporting standards under the UNFCCC, the official emission estimates that are reported by the United States, the Kyoto Protocol, and the Conference of the Parties. Therefore, unless directed by the methodology in a reporting registry, the SAR values remain the basis for CO_2e calculations. The updated IPCC Third Assessment Report (TAR) and Fourth Assessment Report (AR4) GWP values have limited acceptance as reporting convention due to the Kyoto Protocol reliance on IPCC SAR, and the associated legal issues are bound to the SAR until 2012.

Methane remains a value in flux. The methane GWP includes the *direct* effects and those *indirect* effects due to the production of tropospheric ozone and stratospheric water vapor. The indirect effect due to the production of CO_2 is not included. Therefore, significant uncertainty exists surrounding the methane GWP value and the factor is likely to remain uncertain for a period of time. GWP values are generally not attributed to gases that are short-lived or highly reactive (e.g. water vapor, carbon monoxide, tropospheric ozone, other ambient air pollutants (e.g., NO_x , and NMVOCs), and tropospheric aerosols (e.g., SO_2 products and black carbon) and spatially inhomogeneous in the atmosphere.

Table 2-1. GWP (100-year) for CO₂, Methane, and N₂O.

GHG	GWP (SAR) ^A	GWP (TAR) ^B	GWP (AR4) ^C
Carbon dioxide (CO ₂)	1	1	1
Methane (CH ₄)	21	23	25
Nitrous oxide (N ₂ O)	310	296	298

^A Intergovernmental Panel on Climate Change (IPCC) “Second Assessment Report, Climate Change 1995

^B IPCC Third Assessment Report (TAR), Climate Change 2001

^C IPCC Fourth Assessment Report (AR4), Climate Change November 17, 2007

Equation 2-1 shows the CO₂e calculation.

$$CO_2e \left(\frac{\text{tonne } CO_2e}{\text{yr}} \right) = GHGi \left(\frac{\text{tonne } GHGi}{\text{yr}} \right) * GWPi \left(\frac{\text{tonne } CO_2e}{\text{tonne } GHGi} \right) \quad \text{Eqn 2-1}$$

Where:

CO₂e – annual emissions of GHGi expressed as carbon dioxide equivalents;

GHGi – annual emissions of GHGi;

GWP_i – Global Warming Potential of GHGi (e.g., 21 for methane based on SAR values)

Total GHG emissions for an emission sources are calculated by summing the CO₂e values from all associated GHGs (e.g. CO₂, CH₄, and N₂O).

2.2 GHG Emission Source Categories

For natural gas T&S GHG emission inventories, GHG emissions are typically classified as vented, combustion, fugitive, mobile source, or indirect (i.e. purchased electricity).

- Vented emissions are direct gas releases to the atmosphere of natural gas or hydrocarbon gas containing CH₄ and/or CO₂ (not including stationary combustion flue gas) resulting from equipment design, regular process operations, maintenance activities, or emergency releases. Vented emissions may occur on either a continuous or intermittent basis and include, but are not limited to, process designed flow to the atmosphere through seals or vent pipes (e.g. venting of still-column off-gas by glycol dehydrators), equipment blowdown for maintenance or an emergency, and direct venting of gas used to power equipment (such as pneumatic devices).
- Combustion emissions include CO₂ from oxidized hydrocarbons, methane from incomplete combustion, and N₂O formed in combustion zones. Water, oxides of nitrogen, carbon monoxide, and hydrocarbons resulting from incomplete combustion are also emitted. These emissions depend on the stationary (i.e. not mobile sources) combustion equipment (e.g. heaters, reciprocating internal combustion engines, gas turbines, flares), fuel composition and

associated heating value (e.g. field gas, pipeline natural gas, and diesel), and operating condition (e.g. air-to-fuel ratio).

- Fugitive emissions are unintentional leaks of gas containing CH₄ and CO₂ from piping and associated equipment components (e.g., from valve seals, packing, threaded connections, or gaskets, or leaks - resulting from corrosion, faulty connection, etc.). Fugitive sources tend to be continuous emitters and have low to moderate emission rates.

The GHG Mandatory Reporting Rule (40 CFR 98) uses the term “equipment leaks” rather than historical term fugitive emissions.

- Mobile source emissions include CO₂ from oxidized hydrocarbons, methane from incomplete combustion, and N₂O formed from the burning of fuels by transportation devices. These emissions depend on the mobile source (e.g. automobiles, light duty trucks, marine transport), the fuel composition (e.g. petrol, diesel), and source operation (e.g. idling, accelerating, or constant speed).
- Indirect emissions are emissions that are a consequence of the reporting company operations, but occur at sources owned or controlled by another company. These include GHGs emitted during the production of purchased electricity used during T&S operations. These emissions depend on the electric power generation technology (e.g. boiler, turbine, hydroelectric) and fuel combusted (e.g. natural gas, coal); therefore, these emissions vary considerably across the US and include the combustion GHGs (CH₄, CO₂, and N₂O).

Vented and fugitive emission terminologies are often inappropriately comingled and cross referenced. For example, gas that leaks through a closed reciprocating compressor blowdown valve and exits out a vent stack has the characteristics of a fugitive emission (i.e. unintentional valve seal leak) but is commonly defined as a vented emission source. For the purpose of this paper, the emission source defines the category and does not consider whether the release is directed through a vent stack.

2.3 GHG Emission Estimation Methods

GHG emission estimation methodologies for T&S include direct measurements, mass balance and engineering calculations, and emission factors.

- Direct measurement is typically an accurate emissions estimation method. Continuous stack emission monitoring, source tests, or vent gas flow rate measurements can be used; however, direct measurements are generally time consuming and expensive, and often impractical for the majority of greenhouse gas emission sources. Direct measurement also represents a “snapshot in time” and may not represent the source emissions over a longer time interval.
- Mass balance calculations may be used to estimate CO₂ and CH₄ emissions from combustion. The quantity of fuel combusted (measured or estimated), a representative fuel analysis (carbon content), and combustion efficiency (typically 98 – 100%) are input to stoichiometric combustion equations to estimate carbon dioxide emissions. Because these parameters can be accurately measured or estimated, these CO₂ emission estimates are generally much more accurate than emission factor-based estimates (i.e. for fugitive and vented emission sources). Methane emissions from natural gas fuel-fired equipment can be estimated from the quantity of fuel combusted, a representative fuel analysis (CH₄ content), and combustion efficiency.

- Engineering data based emission estimates are based on engineering principles applied to measured and/or approximated physical parameters. These estimates can be used for vented gas events provided reliable activity data including frequency of events, average volume of gas vented per event (function of equipment dimensions, and gas temperature and pressure change), and average gas composition (CH₄ and CO₂) are available. These emission estimates are typically more accurate than emission factor-based estimates which frequently have very high uncertainties.
- Emission factor based emission estimates are used when the exact location and timing of the GHG emissions are impossible or impractical to measure and count. These estimates are determined from the product of an emission factor (EF) and corresponding activity data (AD) (e.g. equipment counts, pipeline miles, throughput, production rates) and are typically used for fugitive and indirect emission estimates, and for select combustion, mobile, and vented emission estimates. Emission factor-based emission estimates usually have the highest uncertainties of the four methods. Increased emissions estimation accuracy requires more detailed data and calculations.

The GHG Mandatory Reporting Rule (40 CFR 98) stipulates emission estimates based on all four of these methodologies. In addition, detailed presentations of GHG emission estimation methodologies and tiers are available in the INGAA Greenhouse Gas Emission Estimation Guidelines for Natural Gas Transmission and Storage [INGAA 2005].

2.4 GHG Emission Inventories and Regulations

Federal and state mandated GHG inventory development and reporting requirements are ongoing and continue to evolve. The sections below address the primary regulatory drivers for GHG emissions reporting.

2.4.1 GHG Emission Inventories

Natural gas industry companies have been participating in voluntary GHG emission inventory and emission reduction programs for several years. Examples include The Climate Registry, the California Climate Action Registry, EPA Natural GasSTAR, DOE EIA 1605b, and the Carbon Disclosure Project. Numerous guidelines are available for preparing natural gas industry GHG emission inventories. Examples include the INGAA Greenhouse Gas Emission Estimation Guidelines for Natural Gas Transmission and Storage [INGAA 2005], the API *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry* [API 2009], the Canadian Association of Petroleum Producers (CAPP) Guide *Calculating Greenhouse Gas Emissions* [CAPP 2003], the International Petroleum Industry Environmental Conservation Association, “Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions” [IPIECA 2003], US Department of Energy, EIA “Technical Guidelines: Voluntary Reporting of Greenhouse Gases (1605(b)) Program.” [DOE 2007], and the American Gas Association (AGA) “Greenhouse Gas Emissions Estimation Guidelines for Natural Gas Distribution.” [AGA 2008]

2.4.2 GHG Emission Regulations

GHG regulations recently promulgated and finalized by the EPA that will impact the natural gas industry include 40 CFR 98 “Mandatory Greenhouse Gas Reporting” and “The Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule”

The “Mandatory Greenhouse Gas Reporting” (40 CFR 98) was published in the Federal Register on October 30, 2009. For most facilities, the Mandatory Reporting Rule (MRR) applicability threshold is 25,000 metric tons (tonnes) of CO₂ equivalent (CO₂e) emissions in any calendar year starting in 2010. Subparts A, C, and W impact natural gas transmission and storage. Subpart A is the general provisions and Subpart C addresses stationary combustion sources: CO₂, methane, and N₂O emissions must be reported. Subpart W addresses vented emissions and equipment leaks (i.e. fugitive emissions) from petroleum and natural gas systems. Subpart W was re-proposed in early 2010 and the final rule was released November 9, 2010. Natural gas systems were only required to report GHG emissions from combustion in 2010. For 2011, affected natural gas transmission and storage facilities will be required to report GHG emission from combustion equipment, and vented and fugitive emissions from affected sources. For *transmission*, these sources [per §98.232(e)] include:

- Reciprocating compressor rod packing venting,
- Centrifugal compressor venting,
- Transmission storage tanks,
- Blowdown vent stacks,
- Natural gas pneumatic device venting (these include continuous high bleed, continuous low bleed, and intermittent bleed natural gas pneumatic devices); and
- Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters.

For *underground gas storage*, these sources [per §98.232(f)] include:

- Reciprocating compressor rod packing venting,
- Centrifugal compressor venting,
- Natural gas pneumatic device venting (these include continuous high bleed, continuous low bleed, and intermittent bleed natural gas pneumatic devices); and
- Equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters.

These emission sources are further defined and discussed in Section 4.

The Prevention of Significant Deterioration construction permit program and Title V operating permit program - Greenhouse Gas Tailoring Rule establishes thresholds for GHG emissions that define when permits under the New Source Review Prevention of Significant Deterioration (PSD) and Title V Operating Permit programs are required for new and existing industrial facilities. The Clean Air Act (CAA) permitting program major source threshold emissions for criteria pollutants such as sulfur dioxide and nitrogen dioxide are 100 and 250 tons per year

(tpy). While these thresholds have been established for criteria pollutants, they are not plausible for GHGs because GHGs are emitted in much higher volumes. The tailoring rule will have a two step phase in and provides much higher thresholds for GHGs.

Step 1 (applies January 2, 2011 – June 30, 2011) permitting requirements for GHG emissions under PSD and Title V will only affect sources currently subject to the PSD construction and Title V operating permitting programs (i.e., PSD and Title V applicability based on emissions of a pollutant other than GHGs). For affected PSD projects, only GHG increases of 75,000 tpy or more of CO₂e would need to determine the Best Available Control Technology (BACT) for their GHG emissions. During Step 1 no sources would be subject to CAA permitting requirements due solely to GHG emissions.

For Step 2 (applies July 1, 2011 to June 30, 2013), PSD permitting requirements will consider applicability based solely on the GHG emissions. New construction projects that emit GHG emissions of at least 100,000 tpy will be subject to PSD regardless of other pollutant permitting thresholds. Similarly, existing facility modifications that increase GHG emissions by 75,000 tpy or more will be subject to permitting requirements. Title V operating permit requirements will apply to facilities that emit at least 100,000 tpy CO₂e, regardless of other pollutant permitting thresholds.

Additional information regarding the Tailoring Rule and potential additional rulemaking steps can be found at: <http://www.epa.gov/NSR/documents/20100413fs.pdf>

3.0 Commonly Defined Petroleum and Natural Gas Systems Industry Borders

The natural gas industry extends from the wellhead (i.e., exploration and production) to the burner tip (i.e., distribution to end users). Subpart W of the GHG MRR covers Petroleum and Natural Gas Systems and lists eight industry segments:

- Offshore petroleum and natural gas production;
- Onshore petroleum and natural gas production;
- Onshore natural gas processing plants;
- Onshore natural gas transmission compression;
- Underground natural gas storage;
- Liquefied natural gas (LNG) storage;
- LNG import and export equipment; and
- Natural gas distribution.

All of these segments include GHG emissions associated with natural gas losses (i.e., from methane in the natural gas). For the purposes of GHG emission estimates, this section defines the borders for the natural gas transmission and storage segments. Appendix A provides a more complete discussion of all of the industry segments, and defines borders with other industries (e.g., electric power generation) and within the oil and gas segments.

Some facility definitions for Subpart W reporting do not include all natural gas industry equipment (e.g., natural gas transmission pipelines are excluded from Subpart W reporting); thus, discussion is provided where Subpart W natural gas segment borders differ from traditional industry borders. For some industry segments (e.g., onshore natural gas processing, onshore natural gas transmission compression, and offshore petroleum and natural gas production), identifying the facility is more straightforward since typically there are physical borders and ownership structures that lend themselves to identifying the scope of GHG reporting and the responsible reporting entity. However, for other segments this determination is more challenging and in some cases will require a case-by-case determination.

Section 3.1 (and Appendix section A-1) defines and discusses natural gas industry borders (e.g., with oil production). To the extent possible, this section and Appendix A attempt to delineate physical borders, identify operating activity demarcation and structures, and examine common segment definitions while avoiding double counting. These borders are essential for the purpose of establishing reporting scope and responsible reporting entities.

3.1 Natural Gas Industry Borders

Guidelines from the 1996 GRI/EPA Study “Methane Emissions from the Natural Gas Industry” [GRI 1996] are used for setting the natural gas industry borders for GHG emission estimates.

For gas transmission companies that transfer gas to end users through farm taps or direct industrial sales lines, all equipment up to and including the customer meter are included in the natural gas industry. The natural gas industry border occurs at the customer meter (i.e., point of custody transfer); end user piping, combustion, and vented emissions after this custody transfer point are not included. Gas transmission companies typically receive natural gas from processing plants, and onshore and offshore production.

3.2 Natural Gas Segment Descriptions and Borders

Figure 3-1 shows the primary GHG emitting equipment and operations for the eight industry segments required to report GHG emissions under Subpart W of the GHG Mandatory Reporting Rule. Segment borders are typically at a point of custody transfer – or where the transfer typically occurs if ownership (i.e., custody transfer) does not change. For example, city gates metering and regulatory (M&R) stations associated with the addition of odorant (e.g., mercaptans) are the typical borders for the Transmission and Distribution segments. This figure also shows the typical segment borders but does not necessarily consider all potential segment borders; for example, a processing plant could deliver gas directly to a Distribution company.

Additional discussion is provided in this section for natural gas transmission and underground storage segments. Detail regarding the equipment and operations, and borders for other segments are provided in Appendix A, which reiterates some material from this section along with the detail for other industry segments. The appendix also provides additional detail on the Subpart W segment description.

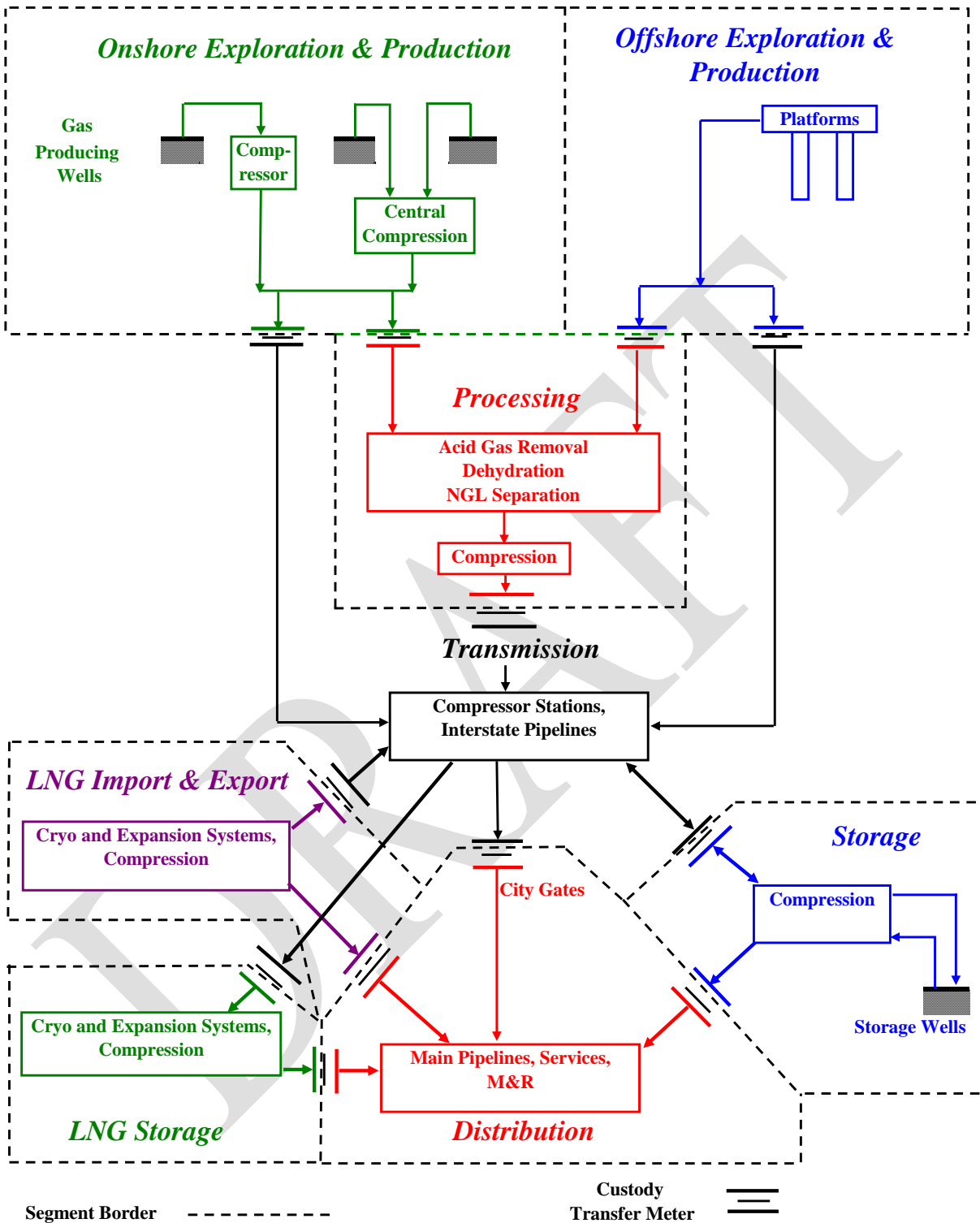


Figure 3-1. Typical natural gas industry segment borders, and primary equipment and operations.

3.2.1 Onshore natural gas transmission compression

"Onshore natural gas transmission compression means any stationary combination of compressors that move natural gas at elevated pressure from production fields or natural gas processing facilities in transmission pipelines to natural gas distribution pipelines or into storage. In addition, transmission compressor stations may include equipment for liquids separation, natural gas dehydration, and tanks for the storage of water and hydrocarbon liquids. Residue (sales) gas compression operated by natural gas processing facilities are included in the onshore natural gas processing segment and are *excluded* from this segment. This source category does not include reporting of emissions from gathering lines and boosting stations – these sources are currently not covered by subpart W." [§98.230(a)(4)]

In addition to the equipment and operations listed in the Subpart W definition, the gas transmission segment includes metering stations (such as farm taps) and the gas transmission pipelines which are used to transfer natural gas across long distances. Subpart W does *not* require reporting of emissions from transmission pipelines and metering stations.

As discussed above, gas transmission companies typically receive natural gas from processing plants, and onshore and offshore production. LNG import terminals and underground storage facilities can also provide gas to transmission pipelines. Gas is typically transported to gas distribution, underground storage, LNG storage, and LNG export facilities and the segment border is defined as the custody transfer point. For transmission-to-distribution transfer, City Gates metering and regulatory (M&R) stations associated with custody transfer and the addition of odorant (e.g. mercaptans) are the typical borders.

The use of custody transfer to define the segment borders is consistent with current regulation. From 40 CFR 63 Subpart HH "NESHAP for Oil and Natural Gas Production Facilities"

"natural gas enters the natural gas transmission and storage source category after the natural gas processing plant, when present. If no natural gas processing plant is present, natural gas enters the natural gas transmission and storage source category after the point of custody transfer."

It should be noted that W is a stand alone rule independent of all other regulations; for example, the facility definitions for onshore production and distribution differ from the traditional CAA rule facility definition, are unique to Subpart W, and do not apply to any other CAA regulation. The HH segment border definition is presented to provide further clarification and note consistency.

3.2.2 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.” [§98.230(a)(5)]

Gas storage facilities primarily receive natural gas from transmission pipelines during periods of low gas demand and return the gas to the pipeline when gas demand increases. Some storage systems provide some low pressure gas directly to distribution systems. The segment borders for these gas flows is the custody transfer point.

3.3 Multi-Purpose and Co-Located Facilities

For some natural gas equipment and operations at “multi-purpose” facilities – i.e., where multiple Subpart W segment facilities are co-located, defining the industry segment or determining the equipment and sources to report is not always straightforward. Terms such as common ownership, common control and contiguous or adjacent are used to assist in determining whether a single or multiple facility segment reporting is required. EPA has provided inconsistent feedback on defining sources to report and that issue should be addressed soon as Subpart W reporting is implemented.

Where a piece of equipment serves a dual purpose, such as a transmission compressor that also can operate as a gas storage compressor, the GHG reporting rule indicates this piece of equipment should be reported under the majority use industry segment. EPA concluded that most of the potential dual-purpose equipment will have the same emissions reporting requirements in either industry segment, so reporting under only one majority use segment will avoid double counting. EPA recognizes that not all emissions are reported for each segment, such as emissions from a dehydrator located at a compressor station or storage facility. In general, Subpart W attempts to capture the emission sources for each segment that comprise at least 85% of the GHG emissions for the particular segment.

EPA provides the following example: some data may not be reported where the obvious industry segment (e.g., processing facility) has one or a few producing wells inside the facility fence and the processing facility owner/operator does not have enough production emissions in the basin surrounding the processing facility to meet the reporting threshold under onshore production. However, the implications for co-located *facilities*, where multiple facilities from more than one segment are located within common or shared boundaries, are not straightforward. Those situations need to be considered on a case-by-case basis.

4.0 Nomenclature and Naming Conventions.

Nomenclature, terminology, equipment classification or assignments and definitions for natural gas transmission and storage greenhouse gas emission sources are presented in this section in alphabetical order. Nomenclature and definitions for associated equipment and operations, and other pertinent information are also presented. Emission source descriptions include a discussion of the emission mechanism, parameters impacting GHG emissions, and emission point/measurement location if not the source itself.. For nomenclature with alternative naming conventions, the definition or description is included with the primary naming convention and the alternative naming convention refer to the primary.

For equipment and operations that have a definition or description in Subparts A, C, or W of the Mandatory Reporting Rule, this definition or description from the rule, preamble, or other supporting documentation is provided. For some of these definitions, alternative definitions or descriptions are also included to provide additional detail and clarity. Table 4-1 at the end of this section is a list of emission sources and associated equipment, operations, and other nomenclature with definitions in the definition sections of Subpart A (i.e. §98.6) and Subpart W (i.e. §98.230 and §98.238).

Parameter	Definition	Source
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.	40 CFR 98 Subpart A
Accidental discharges	means releases of oil, produced water, process chemicals and/or natural gas to the environment by human error, equipment malfunction, or a major equipment failure (e.g., pipeline break, well blow out, explosion, etc.).	CEPEI 2006
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.	40 CFR 98 Subpart A
Accuracy (<i>alternative</i>)	the accuracy of a measurement system is the degree of closeness of measurements of a quantity to its actual (true) value.	
Acid gas	means hydrogen sulfide (H ₂ S) and/or carbon dioxide (CO ₂) contaminants that are separated from sour natural gas by an acid gas removal unit.	40 CFR 98 Subpart W

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.	40 CFR 98 Subpart W
Acoustic leak detectors	are devices that sense and measure the decibel reading of high frequency vibrations and noise of fluids leaking through small cracks or openings. Valves which are not tightly closed will generate a high frequency noise depending on the valve type and size, the pressure drop across the closed valve, and the fluid density. This frequency can be measured in decibels and correlated with through valve leakage rate.	40 CFR 98 Subpart W TSD
Activity	any action or operation that causes or influences the release of greenhouse gases.	IPIECA 2003
Activity data	the activity data of a particular source is a measure of the annual "usage" of that source or the frequency of an emissions-generating event. It is multiplied by an emission factor, which is an estimate of the emissions from that source, to obtain the annual emission rate. For example, to estimate fugitive emissions from a pipeline, the emission factor is given in lb/mile-yr, and the activity data are in units of miles, to give an emission rate of lb/yr.	OTD 2009
Administrator	means the Administrator of the U.S. Environmental Protection Agency or the Administrator's authorized representative (e.g., delegated state agency).	40 CFR 98 Subpart A
AGA	means the American Gas Association	40 CFR 98 Subpart A
Air injected flare	means a flare in which air is blown into the base of a flare stack to induce complete combustion of gas.	40 CFR 98 Subpart A
Anemometer – hot wire	is an instrument used to measure the speed of a gas flow. It consists of an electrically heated wire exposed to the gas flow. The gas speed and thermal properties affect the rate at which the wire loses heat. The gas speed is typically determined by measuring the electrical current necessary to maintain the wire at a constant temperature. Volumetric flowrate is calculated from the gas speed and cross-sectional area of the duct or stack.	

Anemometer – vane	is an instrument used to measure the speed of a gas flow. A small fan is turned by air flowing over the vanes and the fan speed is measured by a revolution counter and converted to a speed. Volumetric flowrate is calculated from the cross-sectional area.	
ANSI	means the American National Standards Institute	40 CFR 98 Subpart A
API	means the American Petroleum Institute.	40 CFR 98 Subpart A
ASME	means the American Society of Mechanical Engineers.	40 CFR 98 Subpart A
ASTM	means the American Society of Testing and Materials.	40 CFR 98 Subpart A
Barrel	one barrel is defined as 42 U.S. gallons.	
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).	40 CFR 98 Subpart W
bbl	means barrel.	40 CFR 98 Subpart A
Block valve station	a block valve used to isolate a segment of the main transmission pipeline for tie-in or maintenance purposes. Block valves are located at distances of 25 to 80 km along each line to limit the amount of piping that may need to be depressurized for tie-ins and maintenance, and to reduce the amount of gas that would be lost in the event of a line break.	CEPEI

Block/isolation valve	<p>a block valve used to isolate a segment of a main pipeline, process unit or equipment (e.g. compressor) for tie-in or maintenance purposes. Block valves are located to reduce the amount of gas that would be lost in the event of a line break or during depressurization for routine maintenance activities. For gas compressors, gas can leak from the pipeline across closed compressor block valve into off-line units that are partially or completely depressurized. The leak rate will depend on the pressure differential, block valve size and design, and valve maintenance practices. These valves operate in a vibrational environment and undergo thermal cycling; thus, leaks develop and increase over time, and the maintenance interval can impact the average leak rate. Emissions are measured from open unit blowdown valves for completely depressured units, and from blowdown valve and compressor rod packing vent lines for partially depressurized units.</p>	OTD 2009
Blow-by	<p>gas from a reciprocating internal combustion engine piston cylinder that leaks past the piston rings into the crankcase.</p>	
Blowdown	<p>means 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.</p>	40 CFR 98 Subpart A
Blowdown (<i>alternative</i>)	<p>venting of gas from equipment for maintenance or emergency purposes. Emissions depend on the equipment internal volume, operating temperature, frequency of blowdown events, and pre- and post-blowdown gas pressures.</p>	
Blowdown vent stack emissions	<p>mean natural gas and/or CO₂ released due to maintenance and/or blowdown operations including compressor blowdown and emergency shut-down (ESD) system testing.</p>	40 CFR 98 Subpart A
Boiler	<p>means an enclosed device using controlled flame combustion and having the primary purpose of recovering thermal energy in the form of steam or hot water.</p>	40CFR63 Subpart DDDDD §63.7575

Booster station	means centralized stations where produced natural gas from individual wells is co-mingled, compressed for transport to processing plants, transmission and distribution systems, and other gathering/booster stations which co-mingle gas from multiple production gathering/booster stations. Such stations may include gas dehydration, gravity separation of liquids (both hydrocarbon and water), pipeline pig launchers and receivers, and gas powered pneumatic devices.	40 CFR 98 Subpart W (proposed rule, not included in final rule)
Border meter station	a meter station where custody of the gas is transferred from one gas transmission system to another at a provincial or national border. These stations are usually larger than normal meter stations. Typically, they have 10 to 20 large diameter meter runs (16 NPS to 20 NPS lines) and no pressure regulation.	CEPEI
Boundary	the determination of which emissions are accounted for and reported by a company. GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, business unit, other.	IPIECA 2003
Brake-specific fuel combustion	refer to Heat rate.	
British thermal unit (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.	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Butane, or n-Butane	is a paraffinic straight-chain hydrocarbon with molecular formula C_4H_{10} .	40 CFR 98 Subpart A
Calculation methodology	means a methodology prescribed under the section "Calculating GHG Emissions" in any 40 CFR 98 Subpart of part 98.	40 CFR 98 Subpart A

<p>Calculation tier</p>	<p>calculation tiers offer a range of detail for calculating emissions. Successively higher tiers require more specific user inputs, but are expected to generate more accurate emission estimates.</p> <p>For 40 CFR 98 Subpart C estimates of CO₂ emissions from fuel combustion: Tier 1 calculation methodology is based on estimated volume of fuel combusted, a default fuel HHV, and a default fuel-specific CO₂ emission factor; Tier 2 calculation methodology is based on estimated volume of fuel combusted, a measured fuel HHV, and a default fuel-specific CO₂ emission factor; Tier 3 calculation methodology is based on measured volume of fuel combusted and a measured fuel composition; and Tier 4 calculation methodology is based on data from continuous emission monitoring systems (CEMS).</p>	<p>OTD 2009 & 40 CFR 98 Subpart C</p>
<p>Calibrated bag (also known as a vent bag)</p>	<p>means a flexible, non-elastic, antistatic bag of a calibrated volume that can be affixed to an emitting source such that the emissions inflate the bag to its calibrated volume.</p>	<p>40 CFR 98 Subpart A</p>
<p>Carbon dioxide (CO₂)</p>	<p>CO₂ is a naturally occurring greenhouse gas formed by the oxidation of atmospheric carbon. It is part of the natural carbon cycle, where carbon is transferred between the atmosphere, land, oceans, living biomass, and mineral reservoirs. Carbon dioxide is also formed through the combustion of carbon-containing fuels.</p>	<p>OTD 2009</p>
<p>Carbon dioxide equivalent (CO₂e)</p>	<p>means the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas, and is calculated using Equation A-1 of this 40 CFR 98 Subpart. $CO_2e = \sum GHGi \times GWPi$; where, GHGi are the mass emissions of each GHG species and GWPi is the global warming potential for GHGi.</p>	<p>40 CFR 98 Subpart A</p>

Carbon dioxide equivalent (CO ₂ e) (alternative)	CO ₂ e compare the ability of different greenhouse gases to trap heat in the atmosphere relative to a base gas, CO ₂ . The CO ₂ equivalent of a particular greenhouse gas is determined by multiplying the mass emissions of the gas by the global warming potential (GWP) for that gas. Total greenhouse gas emissions are expressed as CO ₂ e emissions by multiplying the mass emissions of each GHG by the appropriate GWP and summing the CO ₂ e emissions.	CEPEI
Carbon share	means the percent of total mass that carbon represents in any product.	40 CFR 98 Subpart A
Central compression station	refer to “Booster station”	
Centrifugal compressor	means any equipment that increases the pressure of a process natural gas or CO ₂ by centrifugal action, employing rotating movement of the driven shaft.	40 CFR 98 Subpart A
Centrifugal compressor (alternative)	a compressor that uses blades or impellers to accelerate gas radially, thus imparting kinetic energy to the gas and increasing the pressure. A centrifugal compressor is generally driven by a gas turbine, are common in gas transmission, and are sometimes used in gas gathering.	
Centrifugal compressor dry seal emissions	mean natural gas or 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.	40 CFR 98 Subpart A
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 ₂ from escaping to the atmosphere.	40 CFR 98 Subpart A

<p>Centrifugal compressor dry seals (<i>alternative</i>)</p>	<p>mechanical dry seal systems do not use any circulating seal oil. Dry seals operate mechanically under the opposing force created by hydrodynamic grooves and static pressure. Hydrodynamic grooves are etched into the surface of the rotating ring affixed to the compressor shaft. When the compressor is not rotating, the stationary ring in the seal housing is pressed against the rotating ring by springs. When the compressor shaft rotates at high speed, compressed gas has only one pathway to leak down the shaft, and that is between the rotating and stationary rings. This gas is pumped between the rings by grooves in the rotating ring. The opposing force of high-pressure gas pumped between the rings and springs trying to push the rings together creates a very thin gap between the rings through which little gas can leak. While the compressor is operating, the rings are not in contact with each other and do not need lubrication. O-rings seal the stationary rings in the seal case. Emissions are impacted by gas pressure, seal design, rotational speed, and maintenance practices and are typically measured from a vent line.</p>	<p>GasSTAR</p>
<p>Centrifugal compressor seal system</p>	<p>centrifugal compressors generally require shaft-end seals between the compressor and bearing housings. Either face-contact oil-lubricated mechanical seals or oil-ring shaft seals, or dry-gas shaft seals are used. The amount of leakage from a given seal will tend to increase with wear between the seal and compressor shaft, operating pressure and rotational speed of the shaft.</p>	

<p>Centrifugal compressor wet seal</p>	<p>centrifugal compressors require seals around the rotating shaft to prevent gases from escaping where the shaft exits the compressor casing. Oil is circulated under high pressure between three rings around the compressor shaft, forming a barrier against the compressed gas leakage. The center ring is attached to the rotating shaft, while the two rings on each side are stationary in the seal housing, pressed against a thin film of oil flowing between the rings to both lubricate and act as a leak barrier. “O-ring” rubber seals prevent leakage around the stationary rings. Very little gas escapes through the oil barrier; considerably more gas is absorbed by the oil under the high pressures at the “inboard” (compressor side) seal oil/gas interface, thus contaminating the seal oil. Seal oil is purged of the absorbed gas (using heaters, flash tanks, and degassing techniques) and recirculated. The purged methane is commonly vented to the atmosphere. Emissions generally increase with the compressor size and operating pressure, and are typically measured at the flash tank (or other degassing device) vent.</p>	<p>GasSTAR</p>
<p>Centrifugal compressor wet seal degassing vent emissions</p>	<p>means emissions that occur when the high-pressure oil barriers for centrifugal compressors are depressurized to release absorbed natural gas or CO₂. 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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Certified standards</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>CH₄</p>	<p>means methane.</p>	<p>40 CFR 98 Subpart A</p>
<p>Chemical injection pump</p>	<p>refer to natural gas driven pneumatic pump</p>	<p>40 CFR 98 Subpart A</p>

<p>Chemical injection pump (CIP) (alternative)</p>	<p>gas-driven CIPs are small positive displacement, reciprocating units designed to inject precise amounts of chemicals such as corrosion inhibitors, scale inhibitors, biocide, demulsifier, clarifier, and hydrate inhibitors into process streams. CIPs use gas pressure acting on a plunger to pump a chemical on the opposite side of the plunger. The gas is then vented directly to the atmosphere. Two types of pumps are employed: piston pumps and diaphragm pumps. In piston pumps, gas pressure is applied to a cylindrical piston-plunger assembly to move the plunger. In diaphragm pumps, gas pressure is applied to a flexible diaphragm to move the plunger. Emissions are impacted by unit size (volume displacement of the motive chamber), frequency of operation (pumping rate), supply gas pressure, and operating time (i.e. seasonal or annual operation).</p>	<p>GRI/EPA 1996 Vol. 13</p>
<p>City gate</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>City gate (<i>alternative</i>)</p>	<p>custody transfer or city gate stations include metering in addition to flow or pressure regulation. At these stations natural gas is transferred from a transmission company to a distribution company. The flow or pressure control is conducted by pneumatically controlled valves and the valve pilots may be vented into the atmosphere. The gas is usually metered by both companies, may be passed through a filter and may be reduced in pressure before it enters the distribution company main pipelines. The gas is also odorized at the custody transfer station.</p>	<p>OTD 2009</p>

CO ₂	means carbon dioxide.	40 CFR 98 Subpart A
Coal bed methane (CBM)	means natural gas which is extracted from underground coal deposits or “beds.”	
Cogeneration cycle stationary combustion turbine	means any stationary combustion turbine that recovers heat from the stationary combustion turbine exhaust gases using an exhaust heat exchanger, such as a heat recovery steam generator.	40CFR63 Subpart YYY §63.6175
Combustion efficiency	the extent to which all input combustible material has been completely oxidized (i.e., to produce H ₂ O, CO ₂ and SO ₂). Complete combustion is often approached but is never actually achieved. The main factors that contribute to incomplete combustion include thermodynamic, kinetic, mass transfer and heat transfer limitations. In fuel rich systems, oxygen deficiency is also a factor.	CEPEI
Combustion emissions	include CO ₂ from oxidized hydrocarbons, methane from incomplete combustion, and N ₂ O formed in combustion zones. Water, oxides of nitrogen, and carbon monoxide and hydrocarbons resulting from incomplete combustion are also emitted. These emissions depend on the stationary (i.e. not mobile sources) combustion equipment (e.g. heaters, reciprocating internal combustion engines, gas turbines, flares), fuel composition (e.g. field gas, pipeline natural gas, and diesel), and operating condition (e.g. air-to-fuel ratio).	
Combustion turbine	refer to Turbine, combustion	
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.	40 CFR 98 Subpart A
Common ownership	If the activities are owned by the same person or entity, common control exists. Common ownership may exist in several forms. - if a third party has ownership of fifty-one percent (51%) or more in each of two (2) or more entities, common ownership exists. - if two (2) or more entities share common corporate officers, in whole or in	http://www.in.gov/idem/nrpd_air-005.pdf

<p>Common ownership (continued)</p>	<p>substantial part, who are responsible for the day-to-day operations of the entities, common ownership exists.</p> <ul style="list-style-type: none"> - if one entity has fifty-one percent (51%) or greater ownership of another entity, common ownership exists. <p>Absent common ownership, common control may still exist.</p>	
<p>Common Control</p>	<p><i>Two-pronged test to determine common control.</i></p> <p>The first test focuses on whether one activity is an auxiliary activity which directly serves the purpose of another primary activity and whether the owner or operator of the primary activity has a major role in the day-to-day operations of the auxiliary activity. An auxiliary activity directly serves the purpose of a primary activity by supplying a necessary raw material to the primary activity or performing an integral part of the production process for the primary activity. Day-to-day control of the auxiliary activity by the primary activity is evidenced by several factors.</p> <p>The following is an illustrative list:</p> <ul style="list-style-type: none"> - is a majority of the output of the auxiliary activity provided to the primary activity? - can the auxiliary activity contract to provide its products/services to a third-party without the consent of the primary activity? - can the primary activity assume control of the auxiliary activity under certain circumstances? - is the auxiliary activity required to complete periodic reports to the primary activity? <p>If one or a combination of these questions is answered affirmatively, common control may exist.</p> <p><i>b. But/for test to determine common control</i></p> <p>The second test relevant to determining common control absent common ownership is the but/for test. This test focuses on whether the auxiliary activity would exist absent the needs of the</p>	<p>http://www.in.gov/idem/nrpd_air-005.pdf</p>

Common control (continued)	primary activity. If all or a majority of the output of the auxiliary activity is consumed by the primary activity the but/for test is satisfied.	
Common vent (or Manifoldd common vent or Manifold vent)	when referring to reciprocating compressors, a common vent can include gases leaking from the rod packing (e.g. into the distance piece or other locations) and gases leaking into the crankcase. For a compression station, a common vent can include emissions from more than one compressor.	
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.	40 CFR 98 Subpart A
Component	means each metal to metal joint or seal of non-welded connection separated by a compression gasket, screwed thread (with or without thread sealing compound), metal to metal compression, or fluid barrier through which natural gas or liquid can escape to the atmosphere.	40 CFR 98 Subpart W
Component counts	the number of parts at a site from which fugitive emissions may escape. Categories of components include: connectors, pressure relief valves, open-ended lines, meters, and valves.	OTD 2009 (modified per Subpart W)
Compression ignition	means relating to a type of stationary internal combustion engine that is not a spark ignition engine.	40CFR60 Subpart JJJJ, §60.4248
Compressor	means any machine for raising the pressure of a natural gas or CO ₂ by drawing in low pressure natural gas or CO ₂ and discharging significantly higher pressure natural gas or CO ₂ .	40 CFR 98 Subpart W

Compressor blowdown	compressor gas is fully or partially vented when the equipment is depressurized to be idled or taken off line. Emissions depend on the blowdown type (full or partial) and frequency of the blowdowns, volume emitted (function of pressure and volume), and vent gas disposition (lower pressure system, control system, or atmosphere).	
Compressor blowdown valve	valve on compressor blowdown vent line that remains shut during normal, pressurized compressor operation and is opened to evacuate the compressor for emergency or operational or maintenance purposes. These valves operate in a vibrational environment and can undergo thermal cycling; thus, leakage past the valve seat is not uncommon. Leak rates will depend on the compressor pressure, and valve design and maintenance practices (i.e. the maintenance interval can impact the average leak rate). Emission rates are typically measured from the valve vent line.	
Compressor start	gas used to drive a compressor starter and then vented to atmosphere or a control system. Emissions depend on frequency of startups, gas volume emitted per start up, and vent gas disposition (control system or atmosphere).	
Compressor station	a facility where gas pressure is increased to allow the gas to enter into a higher pressure pipeline system (i.e., feed rather than booster service). Both centrifugal and reciprocating compressor units may be used in these applications. However, use of reciprocating compressors is most common. A station typically comprises several units in series or parallel, as well as the necessary suction and discharge piping. Many compressors also have discharge coolers to reduce the viscosity of the compressed gas and thereby to increase the efficiency of gas transmission. Other compressor station equipment can include separators, dehydrators, pig launchers/receivers, electricity generators, and control equipment.	CEPEI

<p>Compressor relay station <i>(alternative)</i></p>	<p>Compressor stations that boost pressures in transmission lines. They are generally of large volume and operate with low compression ratios, usually less than two. Their pressure range is usually between 200 and 1000 psig, sometimes as high as 1300 psig. Refer to “Compressor station”</p>	<p>Gas Engineers Handbook</p>
<p>Condensate</p>	<p>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.</p>	<p>40 CFR 98 Subpart W</p>
<p>Condensate <i>(alternative)</i></p>	<p>Liquid hydrocarbons of very light crude composition that occur as a gas under subsurface reservoir conditions (high temperature and pressure) and condense into liquid upon production and surface conditions.</p>	<p>API 2009</p>
<p>Connector</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Connector <i>(alternative)</i></p>	<p>is any flanged or threaded connection, or mechanical coupling, but excludes all welded or back-welded connections. If properly installed and maintained, a connector can provide essentially leak-free service for extended periods of time. However, there are many factors that can cause leakage problems to arise. Some of the common causes include vibration, thermal stress and cycles, dirty or damaged contact surfaces, incorrect sealing material, improper tightening, misalignment, and external abuse.</p>	<p>CEPEI</p>

<p>Consensus-based standards</p>	<p>means a method or standard procedure for conducting an engineering measurement published by an organizational body. 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).</p>	<p>§ 98.234(b)</p>
<p>Contiguous/Adjacent</p>	<ul style="list-style-type: none"> - properties that actually abut at any point would satisfy the requirement of contiguous or adjacent property. - properties that are separated by a public road or public property would satisfy this requirement, absent special circumstances. - other scenarios would be examined on an individual basis with the focus on the distance between the activities and the relationship between the activities. 	<p>http://www.in.gov/ideM/nrpd_air-005.pdf</p>
<p>Continuous bleed</p>	<p>means a continuous flow of pneumatic supply gas to the process measurement device (e.g. level control, temperature control, pressure control) where the supply gas pressure is modulated by the process condition, then flows to the valve controller where the signal is compared with the process set-point to adjust gas pressure in the valve actuator.</p>	<p>40 CFR 98 Subpart A</p>
<p>Continuous emission monitoring system or CEMS</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Continuous-bleed pneumatic device</p>	<p>continuous-bleed pneumatic devices are designed to vent gas both when the device actuates and when it is on standby. This is opposed to intermittent-bleed pneumatics which are designed emit gas only when the device actuates. Continuous bleed controllers in compression stations are typically used for liquid level control in filter-separators and pressure reduction.</p>	<p>OTD 2009; GRI/EPA 1996 Vol. 12</p>

Control	the ability of a company to direct the operating policies of another operation. Operational control is defined as the authority to introduce and implement operational and environmental, health, and safety (EHS) policies at an operation.	IPIECA 2003
Control valve	valve used to modulate a process condition such as flowrate, pressure, or temperature.	
Control valve station	a modulating valve that controls either the flow rate or pressure through the pipeline. In the latter case, this facility is often referred to as a regulator station. Usually, high pressure gas from the pipeline is used as the supply medium needed to energize the valve actuator.	CEPEI
Crankcase	the crank case on reciprocating engines and compressors house the crank shaft and associated parts, and typically a supply of oil to lubricate the crank shaft. Integral compressors have a single crank case since the engine and compressor share a common crank shaft. Non-integral compressors typically have two crank cases, one on the engine side and another on the compression side.	
Crankcase vent	vent for gas that accumulates (e.g. from blow-by) in the crankcase.	
Custody transfer	The legal and commercial transfer of a commodity such as natural gas, LNG, etc. from one party to another. This transfer typically employs a meter or measurement.	AGA Glossary
Custody transfer (<i>alternative</i>)	Custody transfer means the transfer of natural gas after processing and/or treatment in the production operations to pipelines or any other forms of transportation.	40 CFR 63 subpart HHH, section 1271
Day	means any consistently designated 24 hour period during which an emission unit is operated.	40 CFR 98 Subpart A
Dehydrator	means a device in which a liquid absorbent (including desiccant, ethylene glycol, diethylene glycol, or triethylene glycol) directly contacts a natural gas stream to absorb water vapor.	40 CFR 98 Subpart A

Dehydrator – Desiccant	solid-bed dehydrators that remove water from raw natural gas by adsorption on bed materials (refer to Desiccant). Vented gas emissions occur when spent bed materials are periodically replaced. Emissions depend on the dehydrator volume, gas pressure and temperature, and bed replacement frequency.	
Dehydrator – Glycol	liquid absorption equipment that remove water from natural gas streams through contact with a liquid glycol stream. The basic equipment are an absorber tower, a pump to circulate the absorber liquid (triethylene glycol or diethylene glycol), and a reboiler to regenerate the absorber liquid by driving off the adsorbed water and hydrocarbons. Small amounts of methane and hydrocarbons absorbed by the liquid may be directly vented to atmosphere from the reboiler or control equipment may be used. Control equipment includes flash tanks and reboiler vent emission controls. Stripping gas - absorber outlet or flash tank gases added to the reboiler flow to boost the water and hydrocarbon desorption from the adsorbing liquid - use is optional. The stripping gas passes through the reboiler and is vented to atmosphere or controls. Emissions depend on volume of gas processed, gas composition (i.e. percent methane), flash tank use, operating pressure and temperature, disposition of flash tank gases, glycol circulation rate, stripping gas use and volume, and reboiler vent controls.	OTD 2009
Dehydrator – Glycol dehydration unit (<i>alternative</i>)	means a device in which a liquid glycol (including, but not limited to, ethylene glycol, diethylene glycol, or triethylene glycol) absorbent directly contacts a natural gas stream and absorbs water in a contact tower or absorption column (absorber). The glycol contacts and absorbs water vapor and other gas stream constituents from the natural gas and becomes “rich” glycol. This glycol is then regenerated in the glycol dehydration unit reboiler. The “lean” glycol is then recycled.	40 CFR 63 subpart HHH, section 1271

Dehydrator vent emissions	means natural gas and CO ₂ released from a natural gas dehydrator system absorbent (typically glycol) reboiler or regenerator to the atmosphere, a condenser, or a flare, including stripping natural gas and motive natural gas used in absorbent circulation pumps.	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Density	means the mass contained in a given unit volume (mass/volume).	40 CFR 98 Subpart A
Desiccant	means a material used in solid-bed dehydrators to remove water from raw natural gas by adsorption or absorption. Desiccants include 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.	40 CFR 98 Subpart A
Destruction efficiency	means the efficiency with which a destruction device reduces the GWP-weighted mass of greenhouse gases fed into the device, considering the GWP-weighted masses of both the greenhouse gases fed into the device and those exhausted from the device. The Destruction Efficiency is expressed in Equation A-2 of this section: $DE = 1 - (tCO_2e_{IN}/tCO_2e_{OUT})$ where: tCO ₂ e _{IN} - The GWP-weighted mass of GHGs fed into the destruction device; tCO ₂ e _{OUT} - The GWP-weighted mass of GHGs exhausted from the destruction device, including GHGs formed during the destruction process.	40 CFR 98 Subpart A

Destruction efficiency, or flaring destruction efficiency <i>(alternative)</i>	refers to the fraction of the gas that leaves the flare partially or fully oxidized.	40 CFR 98 Subpart A
Diaphragm meter	refer to Meter, diaphragm	
Diesel – other	is any distillate fuel oil not defined elsewhere, including Diesel Treated as Blendstock (DTAB).	40 CFR 98 Subpart A
Diesel engine	diesel engine means any stationary RICE in which a high boiling point liquid fuel injected into the combustion chamber ignites when the air charge has been compressed to a temperature sufficiently high for auto-ignition. This process is also known as compression ignition.	40CFR63 Subpart ZZZZ, §63.6675
Diesel fuel	diesel fuel means any liquid obtained from the distillation of petroleum with a boiling point of approximately 150 to 360 degrees Celsius. One commonly used form is number 2 distillate oil.	40CFR60 Subpart IIII, §60.4219
Dig-in	refer to Pipeline dig-in	
Direct emissions	are emissions that are produced by a source owned or controlled by a company. Examples include operations within a company-owned facility, or fuel combusted in a boiler or turbine. Accounting for direct emissions is dependent upon the organizational boundary approach used. See also "indirect emissions."	
Direct greenhouse effects	Radiative effects that occur when the gas itself is a greenhouse gas	
Direct inspection and maintenance (DI&M) program	a maintenance program that involves regularly scheduled leak detection of an entire facility, followed by a repair effort for the identified leaks. The number of leaks is tracked and the total leak rate may also be tracked. Another name commonly used for the DI&M program is leak detection and repair (LDAR).	OTD 2009
Direct-fired heater	refer to Heater, direct-fired	
Distance piece	the distance piece provides the separation of a reciprocating compressor cylinder from the compressor frame. The doghouse refers to the enclosure and is usually equipped with an atmospheric vent.	

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).	40 CFR 98 Subpart A
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 40 CFR 98 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).	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
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).	40 CFR 98 Subpart A
Distribution	refer to Natural gas distribution	
Doghouse	refer to Distance piece.	

E&P Tank	E&P TANK® is a software program developed by the American Petroleum Institute to estimate the working, breathing and flashing components of hydrocarbon production tanks. The E&P TANK program is based on the Peng-Robinson (PR) EOS. The minimum inputs needed for the model are separator oil composition, separator temperature and pressure, sales oil API gravity and Reid Vapor Pressure (RVP), and sales oil production rate and ambient temperature and pressure. The program estimates flashing losses/emissions as well as working and breathing losses.	
Emergency equipment	means any auxiliary fossil fuel-powered equipment, such as a fire pump, that is used only in emergency situations.	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Emission factor	a factor (e.g., pounds of CO ₂ emitted per MMBtu of natural gas combusted or fugitive emissions per mile of pipeline (lb/mile-yr)) relating activity data (e.g. MMBtu of natural gas combusted or miles of pipeline) and absolute GHG emissions.	IPIECA 2003

Emission intensity	A level or amount of emissions per some unit of economic or production output (e.g. sales revenue, MMBtu, or volume of material produced, processed, transported, or sold).	
Emission source	Any physical unit or process that releases greenhouse gases in the atmosphere.	IPIECA 2003
Emission source category	The common emission source categories for the oil and gas industry are vented, combustion, fugitive, mobile, and indirect (purchased electricity).	OTD 2009
Emissions	The intentional and unintentional release of GHGs into the atmosphere.	IPIECA 2003
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.	40 CFR 98 Subpart W
Equipment leak (also refer to Fugitive emissions)	means those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening	40 CFR 98 Subpart W
Equipment leak detection	means the process of identifying emissions from equipment, components, and other point sources.	40 CFR 98 Subpart W
Equivalent leak	is a theoretical model for a pipeline leak that would emit same volume of natural gas over a period of one year as the specific leak does over its actual leaking period within that year.	CEPEI
Equivalent-leak multiplier	is a constant that is used to convert a volume emitted by a specific pipeline leak or leaks during a specific calendar year to a volume emitted during that same calendar year by all leaks, identified or unidentified, in existence on that pipeline or pipeline system during that calendar year.	CEPEI
ESD	abbreviation for Emergency ShutDown.	
Ethane	is a paraffinic hydrocarbon with molecular formula C ₂ H ₆ .	40 CFR 98 Subpart A
Ethylene	is an olefinic hydrocarbon with molecular formula C ₂ H ₄ .	40 CFR 98 Subpart A

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.	40 CFR 98 Subpart W
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.	40 CFR 98 Subpart A
Facility (distribution) (also refer to Natural gas distribution)	with respect to natural gas distribution for purposes of this subpart and for subpart A means the collection of all distribution pipelines, metering stations, and regulating stations that are operated by a Local Distribution Company (LDC) that is regulated as a separate operating company by a public utility commission or that are operated as an independent municipally-owned distribution system.	40 CFR 98 Subpart W
Facility (LNG import and export)	refer to “LNG import and export equipment”	
Facility (LNG storage)	refer to “LNG import and export equipment”	
Facility (offshore production)	refer to “Offshore petroleum and natural gas production”	
Facility (onshore processing)	refer to “Onshore natural gas processing”	

<p>Facility (onshore production) (also refer to Onshore petroleum and natural gas production)</p>	<p>with respect to onshore petroleum and natural gas production for purposes of this subpart and for subpart A means all petroleum or natural gas equipment on a well pad or associated with a well pad and CO2 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.</p>	<p>40 CFR 98 Subpart W</p>
<p>Facility (transmission)</p>	<p>refer to “Onshore natural gas transmission compression”</p>	
<p>Facility (underground storage)</p>	<p>refer to “Underground natural gas storage“</p>	
<p>Farm taps</p>	<p>are pressure regulation stations that deliver gas directly from transmission pipelines to generally rural customers. The gas may or may not be metered, but always does not pass through a city gate station. In some cases a nearby LDC may handle the billing of the gas to the customer(s).</p>	<p>40 CFR 98 Subpart W</p>
<p>Farm tap (<i>alternative</i>)</p>	<p>direct gas sales from a transmission pipeline to an individual customer, usually in rural areas where access to gas distribution system is not available. These facilities have usually only have pressure regulating equipment (gas might be provided free of charge as a consideration for an easement, or the meter is located by the residence as part of the customer meter set).</p>	<p>CEPEI</p>
<p>Field gas</p>	<p>for the purposes of Subpart W reporting, field gas is fuel gas that has a higher heating value less than 950 Btu/scf or does not meet other Subpart A specifications for natural gas</p>	<p>40 CFR 98 Subpart W, inferred definition from §98.233(z)(1)</p>

Field gas (<i>alternative</i>)	untreated natural gas that has not been sweetened; that is, no acid gases such as CO ₂ or H ₂ S have been removed. However, if the field gas is to be used as fuel, H ₂ O, and sometimes H ₂ S, are typically removed. Field gas may also be referred to as raw gas.	
Firetube heaters	refer to Heater, firetube	CEPEI
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.	40 CFR 98 Subpart A
Flare combustion efficiency	means the fraction of hydrocarbon gas, on a volume or mole basis, that is combusted at the flare burner tip.	40 CFR 98 Subpart W
Flare stack emissions	means CO ₂ and N ₂ O from partial combustion of hydrocarbon gas sent to a flare plus CH ₄ emissions resulting from the incomplete combustion of hydrocarbon gas in flares.	40 CFR 98 Subpart W
Flash tanks	are incorporated into glycol dehydration systems to reduce gas emissions. The flash tank is placed in the rich glycol loop between the absorber and the regenerator. The glycol line pressure is dropped in the flash tank, causing most of the hydrocarbons to flash into the vapor phase. The flash gas is usually routed to the regenerator burner as fuel.	GRI/EPA 1996 Vol. 14
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).	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Fossil fuel-fired	means powered by combustion of fossil fuel, alone or in combination with any other fuel, regardless of the percentage of fossil fuel consumed.	40 CFR 98 Subpart A

Four-stroke engine	means any type of engine which completes the power cycle in two crankshaft revolutions, with intake and compression strokes in the first revolution and power and exhaust strokes in the second revolution.	40CFR60 Subpart JJJJ, §60.4248
Fuel	means solid, liquid or gaseous combustible material.	40 CFR 98 Subpart A
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. <i>Note that this definition is specific to 40 CFR 98 and differs from the typical definition of fuel gas – i.e., any gaseous fuel.</i>	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Fugitive emissions	are unintentional leaks of gas containing CH ₄ and CO ₂ from piping and associated equipment components (e.g., from valve seals, packings or gaskets, or leaks from underground pipelines - resulting from corrosion, faulty connection, etc.). Fugitive sources tend to be continuous emitters and have low to moderate emission rates.	CEPEI
Gas conditions	mean the actual temperature, volume, and pressure of a gas sample.	40 CFR 98 Subpart A
Gas gathering station	refer to “Booster station”	
Gas monitor	means an instrument that continuously measures the concentration of a particular gaseous species in the effluent of a stationary source.	40 CFR 98 Subpart A
Gas turbine	refer to Turbine, combustion	

Gas well	means a well completed for production of natural gas from one or more gas zones or reservoirs. Such wells contain no completions for the production of crude oil.	40 CFR 98 Subpart W
Gas-assisted glycol pump	refer to “Absorbent circulation pump”	40 CFR 98 Subpart A
Gas-assisted glycol circulation pump (alternative)	In glycol dehydrators, a lean (low water content) glycol stream is contacted with the wet natural gas and the glycol absorbs most of the water. At locations without electricity, gas-assisted pumps recover energy from the high-pressure/glycol mixture to provide the motive force for circulating the lean glycol. Additional gas is entrained with the glycol to supply the necessary energy and the entrained gas is either removed from the glycol in the flash tank or in the reboiler when the glycol is regenerated. Gas removed from the flash tank is typically burned as fuel, but gas removed in the regenerator is often emitted to the atmosphere. Gas emissions depend on the pump gas usage (scf gas/gallon glycol), circulation rate (gallon glycol/pound water removed from gas), amount of water removed from gas (pound water/MMcf/gas), the overcirculation ratio, and emission control (e.g. gas is combusted as fuel)	GRI/EPA 1996 Vol. 15
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.	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Gate station	refer to City Gate	
Gathering station	refer to “Booster station”	
Global warming potential or GWP	means the ratio of the time-integrated radiative forcing from the instantaneous release of one kilogram of a trace 40 CFR 98 Substance relative to that of one kilogram- of a reference gas, i.e., CO ₂ .	40 CFR 98 Subpart A

GPA	means the Gas Processors Association.	40 CFR 98 Subpart A
GMRC	The Gas Machinery Research Council provides its member companies and industry with the benefits of an applied research and technology program directed toward improving reliability and cost effectiveness of the design, construction, and operation of mechanical and fluid systems.	http://www.gmrc.org/index.html
Greenhouse effect	is the phenomenon whereby certain gases absorb and trap the terrestrial radiation leaving the Earth's surface – thus causing a warming effect on earth.	
Greenhouse gas or GHG	means carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), sulfur hexafluoride (SF ₆), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other fluorinated greenhouse gases as defined in this section.	40 CFR 98 Subpart A
Greenhouse gas (GHG) <i>(alternative)</i>	greenhouse gases absorb and trap the terrestrial radiation leaving the Earth's surface – thus causing a warming effect on earth. The primary GHGs are carbon dioxide and water vapor. Other trace gases in the atmosphere, including methane, nitrous oxide, perfluorocarbons (e.g., C _n F _{2n+2} compounds), hydrofluorocarbons, and SF ₆ , are classified as greenhouse gases. For emissions from oil and natural gas systems, CO ₂ , methane, and nitrous oxide are the most significant greenhouse gases.	
GRI-GLYCalc	is a Windows®-based program for estimating air emissions from glycol units using triethylene glycol (TEG), diethylene glycol (DEG) or ethylene glycol (EG). GLYCalc can be used to predict the impact of combustion devices and condensers on emission rates.	GTI Website
Heat rate	is the amount of heat energy (based on the fuel net or lower heating value) which must be input to a combustion device to produce the rated power output. Heat rate is a measure of the fuel efficiency of a unit and is usually expressed in terms of fuel heat input divided by equipment power output (e.g. net J/kW-hr or Btu/hp-hr).	CEPEI

Heater	is equipment that transfers heat to a gas stream.	OTD 2009
Heater, direct-fired	in a direct fired heater, the combustion gases occupy most of the heater volume and heat the process stream contained in pipes arranged in front of refractory walls (the radiant section) and in a bundle in the upper portion (the convective section). Convective heaters are a special application in which there is only a convective section.	CEPEI
Heater, firetube	in a firetube heater, the combustion gases are contained in a firetube that is surrounded by a liquid that fills the heater shell. This liquid may be either the process stream or a heat medium that surrounds the coil bundle containing the process stream. Common applications are indirect-fired water-bath heaters (line heaters) and glycol reboilers.	CEPEI Equip
Heater, line	is an indirectly fired heater used to heat the fluid in a gas pipeline to above hydrate or freezing temperatures.	CEPEI Equip
Heater, process	means an enclosed device using controlled flame, that is not a boiler, and the unit's primary purpose is to transfer heat indirectly to a process material (liquid, gas, or solid) or to a heat transfer material for use in a process unit, instead of generating steam. Process heaters are devices in which the combustion gases do not directly come into contact with process materials. Process heaters do not include units used for comfort heat or space heat, food preparation for on-site consumption, or autoclaves.	40CFR63 Subpart DDDDD §63.7575
Heating value	The amount of energy released when a fuel is burned completely. It may be reported as higher heating value (HHV) – or gross calorific value – which includes the latent heat of vaporization of the water in the combustion products, or as lower heating value (LHV) – or net calorific value – which does not include the latent heat of vaporization of the water vapor.	IPIECA 2003

High volume sampler	measures the rate of gas leakage from various components (e.g. connectors, valve packings) found in natural gas facilities. A sample is collected from the immediate vicinity of a leak at a large flow rate to completely capture any gas leaking from the component. The sample gas flow rate and natural gas concentration are measured, and the gas leak rate is calculated from these measurements.	
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.	40 CFR 98 Subpart A
Higher heating value (HHV) (<i>alternative</i>)	is the gross amount of energy released (gross calorific value) when a fuel is completely combusted. It does include the latent heat of vaporization of the water vapor. The higher heating value is the lower heating value plus the latent heat of vaporization for the water vapor generated.	IPIECA 2003
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.	40 CFR 98 Subpart A
Hot wire anemometer	Refer to Anemometer - hot wire	
Hydrofluorocarbons or HFCs	means a class of GHGs consisting of hydrogen, fluorine, and carbon.	40 CFR 98 Subpart A
Imaging	means making emissions visible that may otherwise be invisible to the naked eye.	40 CFR 60 subpart A, section 18(g)(3)
Incinerator	means any furnace used in the process of burning solid waste for the purpose of reducing the volume of the waste by removing combustible matter.	40CFR60 Subpart E. §60.51

<p>Indirect emissions</p>	<p>are emissions that are a consequence of the reporting company operations, but occur at sources owned or controlled by another company. These include GHGs emitted during the production of purchased electricity used during T&S operations. These emissions depend on the electric power generation technology (e.g. boiler, turbine, hydroelectric) and fuel combusted (e.g. natural gas, coal); therefore, these emissions vary considerably across the US and include the combustion GHGs (CH₄, CO₂, and N₂O).</p>	<p>IPIECA 2003</p>
<p>Indirect greenhouse effects</p>	<p>are radiative forcing effects that occur when chemical transformation of the original gas produces a greenhouse gas, or when a gas influences the atmospheric lifetimes of other gases.</p>	
<p>Industry standard practice</p>	<p>means a technical standard or procedure resulting from prevalent use that becomes an established norm or requirement. It may be, but is not necessarily, a formal document that establishes uniform engineering or technical criteria, methods, processes, and/or practices.</p>	
<p>Infrared laser beam illuminated instrument (also see Infrared camera and optical gas imaging instruments)</p>	<p>is a leak detection instrument that works on the principle of illuminating an area with infrared laser radiation tuned to a wavelength that is absorbed by the target gas to be detected. The gas plume attenuates some of the backscattered laser light that is detected by the instrument.</p> <p>Laser based instruments are <i>active</i> techniques and employ an artificial radiation source (e.g. a microwave transmitter, a laser, a thermal heater, etc.) for illumination of the target area. Laser sources can be continuous wave or pulsed. These instruments can be either imaging or non-imaging devices.</p> <p>Examples instruments include but are not limited to: backscatter absorption gas imaging (BAGI); open path Fourier transform infrared (OP FTIR); <u>L</u>ight <u>D</u>etection <u>A</u>nd <u>R</u>anging (LiDAR) including <u>R</u>ange, <u>D</u>ifferential <u>A</u>bsorption <u>L</u>IDAR (DIAL), and Doppler; Tunable diode laser absorption spectroscopy (TDLAS).</p>	

<p>Industrial greenhouse gases</p>	<p>means nitrous oxide or any fluorinated greenhouse gas.</p>	<p>40 CFR 98 Subpart A</p>
<p>Infrared camera (also see Infrared laser beam illuminated instrument and optical gas imaging instruments)</p>	<p>IR cameras can be used to observe natural gas flows (e.g. leaks and vents) that are not visible to the naked eye. IR cameras are either passive or active systems. <i>Passive</i> techniques utilize the naturally occurring ambient radiation. <i>Passive</i> methods of chemical detection rely on the imbalance of emission and absorption of chemical species in the field of view (i.e. visual scene) of the instrument. <i>Active</i> techniques employ an artificial radiation source (e.g. a microwave transmitter, a laser, a thermal heater, etc.) for illumination of the target area.</p> <p>IR cameras are imaging devices that provide near real time response to leaks. They rely on the differential absorption typically in the midwave (3-5 micron) infrared (IR) region of the IR spectrum (i.e. outside the visible wavelengths) of the gas plume and background scene. Infrared camera images tend to be monochromatic because the cameras are generally designed with a detector directed at a particular wavelength of infrared radiation.</p> <p>The spectral measurement of the transmitted, reflected, or emitted radiation within the infrared region of the electromagnetic spectrum reveals signatures due to the vibrational transitions that are unique to each molecule and chemical species.</p>	
<p>INGAA</p>	<p>The Interstate Natural Gas Association of America (INGAA), the North American trade association representing interstate and interprovincial natural gas pipeline companies.</p>	<p>http://www.ingaa.org/</p>

<p>Instrument manufacturer's calculation methods</p>	<p>means calculation methods and approaches provided by manufacturers of apparatus used in measuring or detecting GHG's. These methods are typically documented in the instrument manual. Methods typically include a discussion of the calculation, parameters required for the calculation, units, and potentially uncertainty, precision, and/or accuracy. The methods may also include typical operating ranges, limits, and parameter conformance requirements necessary to provide valid measurements or estimates.</p>	
<p>Instrument manufacturer's manual</p>	<p>Also referred to as a user or owners manual, means the reference document that accompanies the GHG detection and measurement instrumentation and provides operating instructions and specifications for the apparatus. The manual may also contain setup instructions and quality assurance and quality control procedures.</p>	
<p>Instrument manufacturer's operating parameters (also refer to manufacturer instructions)</p>	<p>means instrument-specific specifications, limitations, and requirements provided by the manufacturer including typical operating ranges, ambient or source conditions, and parameter conformance requirements necessary to provide valid measurements or estimates.</p>	
<p>Integral compressor</p>	<p>is a reciprocating compressor that shares a common crankshaft and crankcase with the engine.</p>	
<p>Intergovernmental Panel on Climate Change (IPCC)</p>	<p>is an International body of climate change scientists. The role of the IPCC is to assess the scientific, technical, and socio-economic information relevant to the understanding of the risk of human-induced climate change.</p>	<p>IPIECA 2003</p>
<p>Intermittent bleed pneumatic devices</p>	<p>mean automated flow control devices powered by pressurized natural gas and used for maintaining a process condition such as liquid level, pressure, delta-pressure or temperature. These are snap-acting or throttling devices that discharge the full volume of the actuator intermittently when control action is necessary, but does not bleed continuously.</p>	<p>40 CFR 98 Subpart A</p>

Internal combustion	<p>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.</p>	40 CFR 98 Subpart W
Inventory	is a quantified list of an organization's GHG emissions and sources.	IPIECA
IPCC SAR	Intergovernmental Panel on Climate Change Second Assessment Report [IPCC 1995]	
IPCC TAR	Intergovernmental Panel on Climate Change Third Assessment Report [IPCC 2001]	
IPCC AR4	Intergovernmental Panel on Climate Change Fourth Assessment Report [IPCC 2007]	
<p>Isolation valves with displacement operators</p> <p>Also refer to “Block/isolation valve”</p>	<p>Displacement operators are attached to quarter turn plug or ball valves, and are intermittent bleed devices that only emit gas when the valve is actuated. These valves use gas pressure to move an actuator in one direction. The pneumatic force is either applied directly to the actuator element or it is applied to oil so that hydraulic force moves the actuator; gas is discharged when the valve is actuated. Displacement operators in the gas industry are two basic types: 1.) rotary vane, and 2.) piston.</p> <p>The rotary vane displacement operator uses natural gas to force a fixed amount of oil from one pressure vessel to another. The oil moves through the vane operator, delivering hydraulic force to the vane, and moving it and the attached valve stem one quarter turn. The oil moving into the bottle forces gas in the top of the receiving pressure bottle to vent to the atmosphere. For a piston operator, the piston acts on an</p>	GRI/EPA 1996 Vol. 12

<p>Isolation valves with displacement operators (continued)</p>	<p>"arm" or lever that rotates the valve stem. Gas is supplied on one side of the piston and exhausted from the other to move the arm in each direction, either opening or closing the valve.</p> <p>Vented emissions depend on the gas usage per actuation/operation (scf/event) and the number of operations per year. The gas usage per actuation depends on the supply gas pressure and the vane or piston displacement size.</p>	
<p>Isolation valves with turbine operators</p>	<p>Turbine operators are intermittent bleed devices that only emit gas when the valve is actuated. Turbine operators release gas to the atmosphere across a small turbine similar to a gas starter turbine for a reciprocating compressor. The gas spins the turbine blades, and the turbine shaft then turns the gears that move the gate valve stem. Vented emissions depend on the gas usage per actuation/operation (scf/event) and the number of operations per year. The gas usage per actuation depends on the supply gas use rate (scf/min) for the given supply gas pressure and duration of the actuation (min/event). Refer to "Block/isolation valve."</p>	<p>GRI/EPA 1996 Vol. 12</p>
<p>Kimray pump</p>	<p>refer to gas-assisted glycol circulation pump. Kimray is a brand name, but the term is used here to indicate any type of pump where gas pressure is used to operate the pump.</p>	<p>OTD 2009</p>
<p>Kinetics and thermodynamics</p>	<p>thermodynamic equilibrium defines the maximum extent to which a chemical reaction such as combustion may proceed (i.e., the point at which there is no further tendency for change). Chemical kinetics determine the rate at which a chemically reacting system will approach the point of thermodynamic equilibrium.</p>	<p>CEPEI</p>
<p>Kyoto Protocol</p>	<p>is an international agreement, reached in 1997 in Kyoto, Japan, which extends the commitments of the United Nations Framework Convention on Climate Change. In particular, it sets targets for future emissions by each developed country.</p>	

Leak Detection and Repair (LDAR) program	is a maintenance program that involves regularly scheduled leak detection of an entire facility, followed by a repair effort for the identified leaks. The number of leaks is tracked and the total leak rate may also be tracked. Another name commonly used for the LDAR program is Direct Inspection and Maintenance (DI&M).	OTD 2009
Lean-burn engine	Lean burn engine means any two-stroke or four-stroke spark ignited engine that does not meet the definition of a rich burn engine.	40CFR60 Subpart JJJ (§60.4248)
Line heater	Refer to Heater, line	CEPEI
Liquefied natural gas (LNG)	means natural gas (primarily methane) that has been liquefied by reducing its temperature to -260 degrees Fahrenheit at atmospheric pressure.	40 CFR 98 Subpart W
Liquefied natural gas (LNG) import and export equipment	LNG import equipment means all onshore or offshore equipment that receives imported LNG via ocean transport, stores LNG, regasifies 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.	40 CFR 98 Subpart W
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.	40 CFR 98 Subpart W

Liquid removal	<p>When condensable vapors are present in the gas stream in sufficient quantity to liquefy under the anticipated pressure and temperature conditions, the suction stream to each stage of compression (or to each unit, for centrifugal compressors) shall be protected against the introduction of dangerous quantities of entrained liquids into the compressor. Every liquid separator used for this purpose shall be provided with manually operated facilities for removal of liquids there from. In addition, automatic liquid removal facilities or an automatic compressor shutdown device or a high liquid level alarm shall be used where slugs of liquid might be carried into the compressors.</p>	Gas Engineers Handbook
Low-bleed pneumatic devices	<p>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.</p>	40 CFR 98 Subpart A
Lower heating value (LHV)	<p>The net amount of energy released (net calorific value) when a fuel is completely combusted. It does not include the latent heat of vaporization of the water vapor. The lower heating value is the higher heating value minus the latent heat of vaporization for the water vapor generated.</p>	IPIECA 2003
Manufacturer instructions	<p>A document created by the instrument manufacturer that provides detailed installation, operation instructions, and specifications for the apparatus. The document or manual may also contain tutorials, maintenance, troubleshooting, and quality assurance and quality control procedures.</p>	

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.	40 CFR 98 Subpart A
Meter, diaphragm	A meter which uses a flexible diaphragm in a bellows-type arrangement to measure the volume of gas.	OTD 2009
Meter, orifice	A meter using the differential pressure across an orifice plate as a basis for determining the gas volume flowing through the meter.	OTD 2009
Meter, positive displacement	An instrument which measures gas volume on the basis of filling and discharging gas in a chamber.	OTD 2009
Meter, rotary displacement	An instrument which measures volume by means of rotating impellers, matching gears, or sliding vanes.	OTD 2009
Meter, turbine	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.	40 CFR 98 Subpart W
Methane (CH ₄)	is a naturally occurring greenhouse gas produced through anaerobic decomposition of organic matter in biological systems. Methane is also emitted during the production and distribution of natural gas and petroleum, and through incomplete combustion of fossil fuels. The IPCC SAR global warming potential for methane is 21.	OTD 2009
Metric ton	refer to Tonne.	
MMBtu	means million British thermal units.	40 CFR 98 Subpart A
MMhp-hr	abbreviation for million horsepower hours.	
MMscf	means million standard cubic feet. Standard conditions for 40 CFR 98 are 68°F and 14.7 psia.	40 CFR 98 Subpart Y

Mobile source emissions	include CO ₂ from oxidized hydrocarbons, methane from incomplete combustion, and N ₂ O formed from the burning of fuels by transportation devices. These emissions depend on the mobile source (e.g. automobiles, light duty trucks, marine transport), the fuel composition (e.g. petrol, diesel), and source operation (e.g. idling, accelerating, or constant speed).	IPIECA 2003
Mscf	means thousand standard cubic feet. Standard conditions for 40 CFR 98 are 68°F and 14.7 psia.	40 CFR 98 Subpart A
N ₂ O	means nitrous oxide.	40 CFR 98 Subpart A
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.	40 CFR 98 Subpart A
Natural gas distribution (also refer to Facility (distribution))	means the distribution pipelines (not interstate transmission pipelines or intrastate transmission pipelines) and metering and regulating equipment at city gate stations, and excluding customer meters, that physically deliver natural gas to end users and is operated by a Local Distribution Company (LDC) 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 excludes customer meters and 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.	40 CFR 98 Subpart W
Natural gas distribution facility	refer to Facility (distribution)	
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.	40 CFR 98 Subpart A

<p>Natural gas liquids (NGLs)</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>NIST</p>	<p>means the United States National Institute of Standards and Technology.</p>	<p>40 CFR 98 Subpart A</p>
<p>Nitrous oxide (N₂O)</p>	<p>is a naturally occurring greenhouse gas. Nitrous oxide is also formed during fossil fuel combustion. The IPCC SAR global warming potential for N₂O is 310.</p>	
<p>Offshore</p>	<p>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 borders of the jurisdiction and control of the United States under the Outer Continental Shelf Lands Act.</p>	<p>40 CFR 98 Subpart W</p>
<p>Offshore petroleum and natural gas production</p>	<p>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.</p>	<p>40 CFR 98 Subpart W</p>
<p>Oil-fired unit</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>

<p>Onshore natural gas processing.</p>	<p>Natural gas processing separates and recovers natural gas liquids (NGLs) and/or other non-methane gases and liquids from a stream of produced natural gas using equipment performing one or more of the following processes: oil and condensate removal, water removal, separation of natural gas liquids, sulfur and carbon dioxide removal, fractionation of NGLs, or other processes, and also the capture of CO₂ separated from natural gas streams. This segment also includes all residue gas compression equipment owned or operated by the natural gas processing facility, whether inside or outside the processing facility fence. This source category does not include reporting of emissions from gathering lines and boosting stations. This source category includes:</p> <ul style="list-style-type: none"> (i) All processing facilities that fractionate. (ii) All processing facilities that do not fractionate with throughput of 25 MMscf per day or greater. 	<p>40 CFR 98 Subpart W</p>
<p>Onshore natural gas transmission compression</p>	<p>means any stationary combination of compressors that move natural gas at elevated pressure from production fields or natural gas processing facilities in transmission pipelines to natural gas distribution pipelines or into storage. In addition, transmission compressor station may include equipment for liquids separation, natural gas dehydration, and tanks for the storage of water and hydrocarbon liquids. Residue (sales) gas compression operated by natural gas processing facilities are included in the onshore natural gas processing segment and are excluded from this segment. This source category also does not include reporting of emissions from gathering lines and boosting stations – these sources are currently not covered by subpart W.</p>	<p>40 CFR 98 Subpart W</p>

<p>Onshore petroleum and natural gas production</p>	<p>means all equipment on a well pad or associated with a well pad (including compressors, generators, or storage facilities), and portable non-self-propelled equipment on a well pad or associated with a well pad (including well drilling and completion equipment, workover equipment, gravity separation equipment, auxiliary non-transportation-related 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 and all enhanced oil recovery (EOR) operations using CO₂, and all petroleum and natural gas production located on islands, artificial islands, or structures connected by a causeway to land, an island, or artificial island.</p>	<p>40 CFR 98 Subpart W</p>
<p>Onshore petroleum and natural gas production owner or operator</p>	<p>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.</p>	<p>40 CFR 98 Subpart W</p>
<p>Open-ended valve or lines (OELs)</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>

<p>Open-ended valve or lines(OEL) <i>(alternative)</i></p>	<p>an open-ended valve is any valve that may release process fluids directly to the atmosphere from leakage past the valve seat. The leakage may result from improper seating due to an obstruction or sludge accumulation, or because of a damaged or worn seat. An OEL is any segment of pipe that may be attached to such a valve that opens to the atmosphere at the other end. Open-ended valves and lines are typically not designed into process systems. However, they can result from poor operating practices and various process modifications that may occur over time. Some common examples of instances where this type of source may occur include: scrubber, compressor-unit, station and mainline blowdown valves, supply-gas valve for a gas-operated engine starter (i.e., where natural gas is the supply medium), instrument block valves where the instrument has been removed for repair or other reasons, and purge or sampling points.</p>	<p>CEPEI</p>
<p>Operating hours</p>	<p>means the duration of time in which a process or process unit is utilized; this excludes shutdown, maintenance, and standby.</p>	<p>40 CFR 98 Subpart A</p>
<p>Operating pressure</p>	<p>means the containment pressure that characterizes the normal state of gas or liquid inside a particular process, pipeline, vessel or tank.</p>	<p>40 CFR 98 Subpart W</p>
<p>Operation</p>	<p>is a generic term used to denote any kind of business activity.</p>	<p>IPIECA 2003</p>
<p>Operational borders</p>	<p>determine the direct and indirect emissions associated with operations owned or controlled by a reporting company.</p>	<p>IPIECA 2003</p>
<p>Operational change</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Operational control</p>	<p>the authority to introduce and implement operational and environmental, health, and safety (EHS) policies at an operation.</p>	<p>IPIECA 2003</p>
<p>Operator</p>	<p>means any person who operates or supervises a facility or supplier.</p>	<p>40 CFR 98 Subpart A</p>

<p>Optical gas imaging instruments (also see imaging, infrared laser beam illuminated instrument and infrared camera)</p>	<p>means infrared cameras that produce a visible image for the purpose of observing and identifying natural gas leaks from fugitive components and vents that are not visible to the naked eye. For example, refer to "infrared cameras." These instruments can be used to detect fugitive emissions, including gas from transmission storage tank vents, provided they are operated in accordance with 40 CFR 60, subpart A, §60.18 (i)(1) and (2) Alternative work practice for monitoring equipment leaks.</p> <p>Any emissions detected by the optical gas imaging instrument is a leak unless screened with Method 21 (40 CFR part 60, appendix A-7) monitoring, in which case 10,000 ppm or greater is designated a leak per §98.234(a)(1)</p>	
<p>Organizational boundaries</p>	<p>determine the operations owned or controlled by the reporting company. This determination depends on the consolidation approach used (i.e. equity share or operational control approach).</p>	<p>IPIECA 2003</p>
<p>Orifice meter</p>	<p>Refer to Meter - orifice</p>	<p>OTD 2009</p>
<p>Outer continental shelf</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Owner</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Oxidation of methane by soil</p>	<p>is a process of chemical break-up of molecules of methane into other organic and inorganic components as it travels from an underground pipeline to the ground surface through the soil.</p>	<p>CEPEI</p>

Oxides of nitrogen (NO _x)	oxides of nitrogen (usually NO and NO ₂) that are formed during fossil fuel combustion, lightning, soil microbial activity, biomass burning, and, in the stratosphere, from nitrous oxide. Nitrogen oxides are considered ozone precursors and have an indirect effect on climate change because of their role in promoting the formation of tropospheric ozone	
Petroleum	means oil removed from the earth and the oil derived from tar sands and shale.	40 CFR 98 Subpart A
Pilot light	is a small permanent auxiliary flame that ignites the burner of a combustion device when the control valve opens.	40 CFR 98 Subpart C
Pipeline blowdown	is the venting of gas from a pressurized pipeline, usually to the atmosphere.	OTD 2009
Pipeline dig-In	a pipeline dig-in refers to (often unintentional 3rd party) impact with a buried pipeline usually caused by excavation activity in the pipeline right-of-way. The dig-in may cause a pipeline scrape, puncture, or even rupture that cause vented emissions. Emissions depend on pipeline volume and pressure, gas composition (i.e. percent methane), extent of damage, and dig-ins frequency .	OTD 2009
Pipeline leak	fugitive emission through a small opening in the wall of the pipeline or from valves, fittings or connectors attached to that pipeline.	CEPEI
Piston valve operators	valve operators that use pneumatic force (gas pressure) to move a piston. The piston acts on an arm or level that rotates the valve stem. Gas is supplied to one side of the piston and exhausted from the other, so that the arm is moved in either direction, opening and closing the valve. Also refer to “Isolation valves with displacement operators.”	OTD 2009
Plastic pipeline	the plastic pipeline category includes any pipe made of a non-steel material. A common pipeline plastic is PVC (polyvinylchloride), although others (e.g., polyethylene, ABS) are available. It is most commonly used in low-pressure applications (gas distribution, low-pressure gathering systems) and is extremely uncommon in gas transmission.	OTD 2009

Pneumatic/hydraulic valve operators	valve operators that use pneumatic force (gas pressure) to move a valve actuator element in one direction. The pneumatic force is either applied directly to the actuator element or applied to an oil so that hydraulic force moves the actuator. In either case, gas is discharged when the valve is actuated. Also refer to “Isolation valves with displacement operators.”	OTD 2009
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.	40 CFR 98 Subpart A
Positive displacement meter	Refer to Meter, positive displacement	
Power output	For engines power output is the net shaft power available after all losses and power take-offs (e.g., ignition-system power generators, cooling fans, turbo chargers and pumps for fuel, lubricating oil and liquid coolant) have been subtracted. For heaters/boilers it is the net heat transferred to a target process fluid or system.	CEPEI
PRCI	The Pipeline Research Council International is the global collaborative research development organization of, by, and for the energy pipeline industry	http://prci.org/index.php/about/
Precision of a measurement (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.	40 CFR 98 Subpart A

Precision (<i>alternative</i>)	The precision of a measurement system is the degree to which repeated measurements under unchanged conditions show the same results.	
Pressure regulator	A device that maintains the pressure in a fluid flow line, less than its inlet pressure within a constant band of pressures, regardless of the rate of flow in the line or the change in upstream pressure.	OTD 2009
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.	40 CFR 98 Subpart A
Pressure-relief valves (PRV) (<i>alternative</i>)	Pressure relief or safety valves are used to protect process piping and vessels from being accidentally over-pressured. They are spring loaded so that they are fully closed when the upstream pressure is below the set point, and only open when the set point is exceeded. Relief valves open in proportion to the amount of overpressure to provide modulated venting. Safety valves pop to a full-open positions on activation. When relief or safety valves reseal after having been activated, they often leak because the original tight seat is not regained either due to damage of the seating surface or a build-up of foreign material on the seat plug. As a result, they are often responsible for fugitive emissions. Another problem develops if the operating pressure is too close to the set pressure, causing the valve to "simmer" or "pop" at the set pressure. Gas that leaks from a pressure-relief valve may be detected at the end of the vent pipe (or horn). Additionally, there normally is a monitoring port located on the bottom of the horn near the valve.	EPA Phase II Aggregate Site Report - Cost-Effective Directed Inspection and Maintenance Control Opportunities at Five Gas Processing Plants and Upstream Gathering Compressor Stations and Well Sites
Primary fuel	means the fuel that provides the greatest percentage of the annual heat input to a stationary fuel combustion unit.	40 CFR 98 Subpart A

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 ₂ 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.	40 CFR 98 Subpart A
Process heater	Refer to Heater, process	
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.	40 CFR 98 Subpart A
Process vent	means a gas stream that: (1) is discharged through a conveyance to the atmosphere either directly or after passing through a control device; (2) 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 (3) 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.	40 CFR 98 Subpart A
Products of incomplete combustion (PICs)	are any compounds, excluding CO ₂ , H ₂ O, SO ₂ , HCl and HF, that contain C, H, S, Cl or F and occur in the flue gas stream. These compounds may result from thermodynamic, kinetic or transport limitations in the various combustion zones. All input combustibles are potential products of incomplete combustion. Intermediate substances formed by dissociation and recombination effects may also occur as products of incomplete combustion (CO is often the most abundant combustible formed).	CEPEI

Protected Steel Pipeline	steel pipeline that has cathodic protection and exterior coating.	OTD 2009
Pump	means a device used to raise pressure, drive, or increase flow of liquid streams in closed or open conduits.	40 CFR 98 Subpart W
Pump seal emissions	means hydrocarbon gas released from the seal face between the pump internal chamber and the atmosphere.	40 CFR 98 Subpart W
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.	40 CFR 98 Subpart W
Pump seals (<i>alternative</i>)	Positive displacement pumps are normally used for pumping hydrocarbon liquids at oil and gas facilities. Positive displacement pumps have a reciprocating piston, diaphragm or plunger, or else a rotary screw or gear. Packing, with or without a sealant, is the simplest means of controlling leakage around the pump shaft. It may be used on both the rotating and reciprocating pumps. Specially designed packing materials are available for different types of service. The selected material is placed in a stuffing box and the packing gland is tightened to compress the packing around the shaft. All packings leak and generally require frequent gland tightening and periodic packing replacement. Particulate contamination, overheating, seal wear, sliding seal leakage and vibration will contribute to increased leakage rates over time.	CEPEI
Radiative forcing	is a measure of changes in the energy transfers among space, the atmosphere, land, and the oceans.	
Raw gas	refer to Field Gas	
Receipt meter station	is a meter station for measuring the amount of gas being supplied by a given source (e.g. gas processing plant or a gas battery) to a gas transmission system.	CEPEI
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.	40 CFR 98 Subpart A

<p>Reciprocating compressor (<i>alternative</i>)</p>	<p>is a compressor that uses pistons moving back and forth (reciprocating) in cylinders to compress natural gas. These compressors are typically driven by internal combustion engines.</p>	
<p>Reciprocating compressor rod packing</p>	<p>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 CO2 that escapes to the atmosphere.</p>	<p>40 CFR 98 Subpart A</p>
<p>Reciprocating compressor packing systems (<i>alternative</i>)</p>	<p>Compressor rod packing consists of a series of flexible rings that fit around the shaft to create a seal against leakage. The packing rings are typically lubricated with circulating oil to reduce wear, help seal the unit, and draw off heat. Other cooling methods include air cooling, water jacketing, and circulating coolants inside the packing box. Packing rings are held in place by a set of packing cups, normally one for each pair of rings, and kept tight against the shaft by a surrounding spring. The number of cups and rings will vary depending on the compression chamber pressures. A “nose gasket” on the end of the packing case prevents leaks around the packing cups. F</p> <p>The leak rate depends on cylinder pressure, fitting and alignment of the packing parts, and amount of wear on the rings and rod shaft - the maintenance interval can impact the average leak rate. Leakage typically occurs from four areas: Around the packing case through the nose gasket; Between the packing cups, which are typically mounted metal-to-metal against each other; Around the rings from slight movement in the cup groove as the rod moves back and forth; and Between the rings and shaft. Leaking gases are vented, through the compressor distance piece and/or packing vents, to the atmosphere or to a control system. Emissions are measured from the vent lines, or if the distance piece and packing vents are not exhausted through a vent line, a hi-flow sampler can be used to measure the leak rates.</p>	<p>EPA GasSTAR</p>

Reciprocating compressor rod packing case drain	is a system to collect oil and debris scraped from the reciprocating compressor rod. Gas absorbed in the oil is volatilized when the oil reaches atmospheric pressure in the drain. Emissions depend on the oil drain rate, gas pressure, and oil characteristics.	
Reciprocating compressor rod static seal	is a static seal on the compressor rods eliminates rod packing leaks during shutdown when the compressor is kept pressurized. A static seal is installed on each rod shaft outside conventional packing. An automatic controller activates when the compressor is shutdown to wedge a tight seal around the shaft; the controller deactivates the seal on start-up.	EPA GasSTAR
Reciprocating compressor unloader	Compressor cylinder unloaders are valves used to 1) reduce the machine's start-up load, 2) prevent an overload when there is an upset in operating conditions, and 3) control gas volumes due to fluctuations in rate requirements. Unloaders can be a source of gas emissions to the atmosphere from leaking o-rings, covers, and pressure packing, and frequent maintenance.	EPA GasSTAR
Reciprocating compressor valve cover	Gasketed cover to access compressor valves that can be a source of fugitive gas emissions.	
Reciprocating compressor variable volume pocket valve	Pocket valves alter the compressor cylinder head space (clearance volume) and can be a source of fugitive gas emissions.	
Reciprocating internal combustion engine	means any reciprocating internal combustion engine which uses reciprocating motion to convert heat energy into mechanical work.	40CFR63 Subpart ZZZZ, §63.6675; 40CFR60 Subpart III, §60.4219
Re-condenser	means heat exchangers that cool compressed boil-off gas to a temperature that will condense natural gas to a liquid.	40 CFR 98 Subpart A
Regulator	refer to Pressure regulator.	
Reservoir	means a porous and permeable underground natural formation containing significant quantities of hydrocarbon liquids and/or gases.	40 CFR 98 Subpart W

Residue gas	means 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.	40 CFR 98 Subpart W
Residue gas compression	means the compressors operated by the processing facility, whether inside the processing facility border fence or outside the fence-line, that deliver the residue gas from the processing facility to a transmission pipeline.	40 CFR 98 Subpart W
Rich-burn engine	means any four-stroke spark ignited engine where the manufacturer's recommended operating air/fuel ratio divided by the stoichiometric air/fuel ratio at full load conditions is less than or equal to 1.1. Engines where there are no manufacturer's recommendations regarding air/fuel ratio will be considered a rich burn engine if the excess oxygen content of the exhaust at full load conditions is less than or equal to 2 percent.	40CFR60 Subpart JJJJ (§60.4248)
Rotary displacement meter	Refer to Meter, rotary displacement	
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	40 CFR 98 Subpart A

Safety device (continued)	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 meter station	is a meter station for measuring the amount of gas being withdrawn from a gas transmission system by a customer (e.g. gas distribution system, farm or industrial end user). It might include pressure regulating equipment and an odourization system.	CEPEI
Sales oil	means produced crude oil or condensate measured at the production lease automatic custody transfer (LACT) meter or custody transfer tank gauge.	40 CFR 98 Subpart A
scf	An abbreviation for standard cubic foot of gas. Standard conditions for 40 CFR 98 are 68°F and 14.7 psia.	
scm	An abbreviation for standard cubic meter of gas. Standard conditions for 40 CFR 98 are 68°F and 14.7 psia.	
Screening (leaks)	means identification of a leaking fugitive component, or equipment leak or vent	
Scrubber dump valve	liquids captured by a scrubber are dumped to an atmospheric storage tank, often called a slop tank, either manually, or automatically with a liquid level sensing switch and an electric or pneumatic scrubber dump valve. Methane leaks can occur from the dump valve when solids—or liquids freezing in the valve—prevent the dump valve from fully closing. Physical erosion of the valve seats can also cause leaks. Leaks from dump valves that fail to fully close can be significant and are dependent on the pressure in the scrubber. Emissions are typically measured at the tank vapor vent stack (also refer to Scrubbers).	EPA GasSTAR

Scrubbers	are flow-through pressure vessels located at natural gas compression facilities designed to separate solids, water, and hydrocarbon liquids from the natural gas stream, prior to the natural gas entering process equipment. A multi-stage reciprocating compressor will usually have a scrubber on each stage of compression to collect liquids that condense after the prior stage of compression and cooling. They are also usually installed on the inlet to fuel gas systems. The vessel may either be a vertical or horizontal system and be equipped with a manual or automatic liquid dumping system. (also refer to Scrubber dump valve)	EPA GasSTAR
Segment (petroleum and natural gas systems)	means the following eight Subpart W source categories: <ol style="list-style-type: none"> 1. Offshore petroleum and natural gas production; 2. Onshore petroleum and natural gas production; 3. Onshore natural gas processing plants; 4. Onshore natural gas transmission compression; 5. Underground natural gas storage; 6. Liquefied natural gas (LNG) storage; 7. LNG import and export equipment; and 8. Natural gas distribution. 	40 CFR 98 Subpart W
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.	40 CFR 98 Subpart A
Separator	means a vessel in which streams of multiple phases are gravity separated into individual streams of single phase.	40 CFR 98 Subpart W
Shutdown	means the cessation of operation of an emission source for any purpose.	40 CFR 98 Subpart A
Simple cycle combustion turbine	refer to Turbine, simple cycle combustion	
Sinks	are the processes (or places that encompass particular processes) that remove greenhouse gases from the atmosphere.	

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.	40 CFR 98 Subpart A
Sour natural gas	means natural gas that contains significant concentrations of hydrogen sulfide (H ₂ S) and/or carbon dioxide (CO ₂) that exceed the concentrations specified for commercially saleable natural gas delivered from transmission and distribution pipelines.	40 CFR 98 Subpart A
Source	is any process or mechanism which release a greenhouse gas in the atmosphere. The opposite of sinks.	OTD 2009
Source category	means, for the purposes of GHG reporting for 40 CFR 98, an industry and/or group of related emission sources defined by an applicable subpart to 40 CFR 98 (i.e., categories addressed in Subparts C – UU)	40 CFR 98 Subpart W
Spark ignition	means relating to either: a gasoline-fueled engine; or any other type of engine with a spark plug (or other sparking device) and with operating characteristics significantly similar to the theoretical Otto combustion cycle. Spark ignition engines usually use a throttle to regulate intake air flow to control power during normal operation. Dual-fuel engines in which a liquid fuel (typically diesel fuel) is used for compression ignition and gaseous fuel (typically natural gas) is used as the primary fuel at an annual average ratio of less than 2 parts diesel fuel to 100 parts total fuel on an energy equivalent basis are spark ignition engines.	40CFR60 Subpart JJJJ, §60.4248
Standard conditions or standard temperature and pressure (STP)	for the purposes of the GHG Reporting Rule, means either 60 or 68 degrees Fahrenheit and 14.7 pounds per square inch absolute.	40 CFR 98 Subpart A

Stationary fuel combustion sources	for 40 CFR 98 Subpart C, these 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. This source category does not include: Portable equipment, as defined in §98.6; Emergency generators and emergency equipment, as defined in §98.6; Irrigation pumps at agricultural operations; Flares, unless otherwise required by provisions of another subpart of 40 CFR 98 to use stationary fuel combustion source methodologies; and Electricity generating units that are subject to 40 CFR 98 Subpart D.	Subpart C
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.	40 CFR 98 Subpart A
Storage tank losses	Working, breathing and flashing losses from storage tanks.	CEPEI
Storage well	is a well through which natural gas may be either injected or removed from an underground storage cavern. The overall storage system would typically be connected to a gas transmission system.	CEPEI
Straddle plant	Straddle plants are typically sited on or adjacent to major pipeline systems. The natural gas that enters the straddle plant is of pipeline quality; however, for some pipelines the gas still includes valuable quantities of NGLs, which are extracted at the straddle plants. NGL removal can include cryogenic processes, compression, and may also include dehydration.	

Stripping gas	are glycol dehydrator absorber outlet or flash tank gases added to the reboiler flow to boost the water and hydrocarbon desorbition from the adsorbing liquid. The use of stripping gas is optional. The stripping gas passes through the reboiler and is vented to atmosphere or controls. (refer to Dehydrator - glycol)	
Supplemental fuel	means a fuel burned within a petrochemical process that is not produced within the process itself.	40 CFR 98 Subpart A
Sweet gas	is natural gas with low concentrations of hydrogen sulfide (H ₂ S) 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.	40 CFR 98 Subpart A
Thermal efficiency	<p>The percentage or portion of input energy converted to useful work or heat output. For combustion equipment, typical convention is to express the input energy in terms of the net (lower) heating value of the fuel. This results in the following relation for thermal efficiency (η):</p> $\eta = \frac{\text{Useful Work/Heat Output} \times 100\%}{\text{Net Heat/Energy Input}}$ <p>Alternatively, thermal efficiency may be expressed in terms of energy losses as follows:</p> $\eta = \frac{(1 - \Sigma \text{Energy Losses}) \times 100\%}{\text{Net Heat/Energy Input}}$ <p>Losses in thermal efficiency occur due to the following potential factors: Exit combustion heat losses (i.e., residual heat value in the exhaust gases); Air infiltration; Incomplete combustion; and Mechanical losses (e.g., friction losses and energy needed to run cooling fans and lubricating-oil pumps).</p>	CEPEI
Tonne	metric ton, equivalent to 1000 kilograms, 2204.6 pounds, or about 1.10 tons (U.S.).	

Total hydrocarbons (THC)	are all compounds containing at least one hydrogen atom and one carbon atom, with the exception of carbonates and bicarbonates.	CEPEI
Total organic compounds (TOC)	comprises all VOCs plus all non-reactive organic compounds (i.e., methane, ethane, methylene chloride, methyl chloroform, many fluorocarbons, and certain classes of per fluorocarbons).	CEPEI
Trace concentrations	means concentrations of less than 0.1 percent by mass of the process stream.	40 CFR 98 Subpart A
Transmission	refer to Onshore natural gas transmission compression	
Transmission pipeline	means high pressure cross country pipeline transporting saleable quality natural gas from production or natural gas processing to natural gas distribution pressure let-down, metering, regulating stations where the natural gas is typically odorized before delivery to customers.	40 CFR 98 Subpart W
Transmission pipeline (<i>alternative</i>)	is a pipeline used to transport processed, usually unodourized, natural gas to market (i.e., to gas distribution systems and major industrial customers). Most transmission pipelines also have some farm taps which provide gas to farmers located along the pipeline in areas where service from distribution systems is not readily available. The pipelines are usually constructed of steel, although aluminum is used for some lower pressure applications (generally up to 500 psig). The pipe sizes range from 60.3 mm to 1219.2 mm O.D. (2 to 48 NPS), with the mid-range sizes most common. The operating pressures typically range from 1380 to over 6900 kPag (200 to 1000+ psig). For the purposes of calculating methane emissions from transmission pipelines, all small associated facilities such as valve assemblies or pig traps are considered to be part of the pipeline.	CEPEI
Transmission stations	are stations associated with transmission pipelines. They meter and/or regulate the gas pressure. They consist of Receipt/sales stations, Border meter stations and Transmission farm taps.	CEPEI

Transparency	means the assumptions and methodologies used for a GHG emissions inventory should be clearly explained and presented to facilitate replication and assessment of the CO ₂ e emissions estimate.	
Turbine meter	refer to Meter, turbine	40 CFR 98 Subpart W
Turbine valve operators	release gas to the atmosphere across a small turbine similar to a gas starter turbine for a reciprocating compressor. The gas spins the blades, and the turbine shaft then turns gears that move the valve stem.	OTD 2009
Turbine, combustion	is a rotary engine that extracts energy from a flow of combustion gas. It has an upstream compressor coupled to a downstream turbine, and a combustion chamber in-between. Fuel and compressed air are mixed and ignited in the combustor. High pressure combustion products are forced into the turbine section where the high velocity gas flow is directed through a nozzle over the turbine's blades, spinning the turbine which powers the compressor and provides shaft power for stationary units.	
Turbine, simple cycle combustion	means any stationary gas turbine which does not recover heat from the gas turbine exhaust gases to preheat the inlet combustion air to the gas turbine, or which does not recover heat from the gas turbine exhaust gases to heat water or generate steam.	40CFR60 Subpart GG §60.331
Two-stroke engine	means a type of engine which completes the power cycle in single crankshaft revolution by combining the intake and compression operations into one stroke and the power and exhaust operations into a second stroke. This system requires auxiliary scavenging and inherently runs lean of stoichiometric.	40CFR60 Subpart JJJJ, §60.4248
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.	40 CFR 98 Subpart A

<p>Underground natural gas storage</p>	<p>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.</p>	<p>40 CFR 98 Subpart W</p>
<p>Underground storage field stations (<i>alternative</i>)</p>	<p>are compressor stations that compress trunk line gas for injection into storage wells. These stations may discharge at pressures up to 4000 psig, employing compression ratios as high as four. Designs of some storage stations permit withdrawal of gas from storage and forcing it into high pressure lines. Storage field stations require precision design engineering because of their wide range of pressure-volume operating conditions</p>	<p>Gas Engineers Handbook</p>
<p>United States</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Unprotected steel pipeline</p>	<p>Steel pipeline that does not have cathodic protection or external coating.</p>	<p>OTD 2009</p>
<p>Valve</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>

<p>Valves <i>(alternative)</i></p>	<p>are devices for stopping or regulating the flow of a liquid or gas. The different valve types include gate, globe, butterfly, ball, plug, and globe. The first two types are a rising-stem design, and the rest are quarter-turn valves. Valves may either be equipped with a hand-wheel or lever for manual operations, or an actuator or motor for automated operation. There are three main locations on a typical valve where leakage may occur: (1) from the valve body and around the valve stem, (2) around the end connections, or (3) past the valve seat. Leaks of the first type are referred to as valve leaks. Emissions from the end connections are classified as connector leaks. Leakage past the valve seat is only a potential source of emissions if the valve, or any downstream piping, is open to the atmosphere. This is referred to as an open-ended valve or line. The potential leak points on each of the different types of valves are, as applicable, around the valve stem, body seals (e.g., where the bonnet bolts to the valve body, retainer connections), body fittings (e.g., grease nipples, bleed ports), packing guide, and any monitoring ports on the stem packing system. Typically, the valve-stem packing is the most likely of these parts to leak.</p>	<p>CEPEI</p>
<p>Vane anemometer</p>	<p>Refer to Anemometer - vane</p>	
<p>Vapor recovery system</p>	<p>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.</p>	<p>40 CFR 98 Subpart A</p>
<p>Vapor recovery unit (VRU) <i>(alternative)</i></p>	<p>is a system composed of a scrubber, a compressor and a switch to recover vapors formed inside completely sealed crude oil or condensate tanks. The switch detects pressure variations inside the tanks and turns the compressor on and off. The vapors are sucked through a scrubber, where trapped liquid is returned to the liquid pipeline system or to the tanks, and recovered vapor is pumped into gas lines.</p>	

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.	40 CFR 98 Subpart A
Vent bag (also see calibrated bags)	<p>means a flexible, non-elastic, antistatic bag of a calibrated volume that can be affixed to an emitting source such that the emissions inflate the bag to its calibrated volume.</p> <p>Bag of known volume (i.e. typically 10-240 cubic feet per minute) for measuring flow rate over the time required to completely fill the bag. These bags are typically anti-static plastic of various sizes and may contain a neck to fit over vent openings. Vent bags must be selected based on flowrate and provide a low-pressure drop measurement for vent systems that may not tolerate significant backpressure.</p>	<p>40 CFR 98 Subpart A</p> <p><i>Supplemental</i></p>
Vented emissions	means intentional or designed releases of CH ₄ or CO ₂ 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).	40 CFR 98 Subpart W
Vented emissions (<i>alternative</i>)	are direct gas releases to the atmosphere of natural gas or hydrocarbon gas containing CH ₄ and/or CO ₂ (not including stationary combustion flue gas) resulting from equipment design, regular process operations, maintenance activities, or emergency releases. Vented emissions may occur on either a continuous or intermittent basis and include, but are not limited to, process designed flow to the atmosphere through seals or vent pipes (e.g. venting of still-column off-gas by glycol dehydrators), equipment blowdown for maintenance or an emergency, and direct venting of gas used to power equipment (such as pneumatic devices).	CEPEI

Volatile organic compounds (VOC)	means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. VOC excludes methane, ethane, methylene chloride, methyl chloroform, many fluorocarbons, and certain classes of per fluorocarbons.	40CFR51.100(s)
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.	40 CFR 98 Subpart A
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."	40 CFR 98 Subpart A
You	means an owner or operator subject to 40 CFR, Part 98.	40 CFR 98 Subpart A

Table 4-1. List of Terms Defined in 40 CFR 98, Subpart A and Subpart W (weblinks below).

Parameter	Source
Absorbent circulation pump	40 CFR 98 Subpart A
Accuracy	40 CFR 98 Subpart A
Administrator	40 CFR 98 Subpart A
AGA	40 CFR 98 Subpart A
Air injected flare	40 CFR 98 Subpart A
ANSI	40 CFR 98 Subpart A
API	40 CFR 98 Subpart A
ASME	40 CFR 98 Subpart A
ASTM	40 CFR 98 Subpart A
bbf	40 CFR 98 Subpart A
Blowdown	40 CFR 98 Subpart A
Blowdown vent stack emissions	40 CFR 98 Subpart A
British thermal unit (Btu)	40 CFR 98 Subpart A
Bulk natural gas liquid or NGL	40 CFR 98 Subpart A
Butane, or n-Butane	40 CFR 98 Subpart A
Butylene, or n-Butylene	40 CFR 98 Subpart A
Calculation methodology	40 CFR 98 Subpart A
Calibrated bag	40 CFR 98 Subpart A
Carbon dioxide equivalent (CO ₂ e)	40 CFR 98 Subpart A
Carbon share	40 CFR 98 Subpart A
Centrifugal compressor	40 CFR 98 Subpart A
Centrifugal compressor dry seal emissions	40 CFR 98 Subpart A
Centrifugal compressor dry seals	40 CFR 98 Subpart A
Centrifugal compressor wet seal degassing vent emissions	40 CFR 98 Subpart A
Certified standards	40 CFR 98 Subpart A
CH ₄	40 CFR 98 Subpart A
City gate	40 CFR 98 Subpart A
CO ₂	40 CFR 98 Subpart A
Commercial applications	40 CFR 98 Subpart A
Company records	40 CFR 98 Subpart A
Connector	40 CFR 98 Subpart A
Continuous bleed	40 CFR 98 Subpart A
Continuous emission monitoring system or CEMS	40 CFR 98 Subpart A
Day	40 CFR 98 Subpart A
Dehydrator	40 CFR 98 Subpart A
Dehydrator vent emissions	40 CFR 98 Subpart A
De-methanizer	40 CFR 98 Subpart A

Table 4-1. List of Definitions from Subpart A and Subpart W. (cont.)

Density	40 CFR 98 Subpart A
Desiccant	40 CFR 98 Subpart A
Destruction efficiency	40 CFR 98 Subpart A
Destruction efficiency, or flaring destruction efficiency	40 CFR 98 Subpart A
Diesel – other	40 CFR 98 Subpart A
Distillate fuel No. 1	40 CFR 98 Subpart A
Distillate fuel No. 2	40 CFR 98 Subpart A
Distillate fuel No. 4	40 CFR 98 Subpart A
Distillate fuel oil	40 CFR 98 Subpart A
Emergency equipment	40 CFR 98 Subpart A
Emergency generator	40 CFR 98 Subpart A
Ethane	40 CFR 98 Subpart A
Ethylene	40 CFR 98 Subpart A
Facility	40 CFR 98 Subpart A
Flare	40 CFR 98 Subpart A
Flowmeter	40 CFR 98 Subpart A
Fossil fuel	40 CFR 98 Subpart A
Fossil fuel-fired	40 CFR 98 Subpart A
Fuel	40 CFR 98 Subpart A
Fuel gas	40 CFR 98 Subpart A
Fuel gas system	40 CFR 98 Subpart A
Gas conditions	40 CFR 98 Subpart A
Gas monitor	40 CFR 98 Subpart A
Gas to oil ratio (GOR)	40 CFR 98 Subpart A
Gaseous fuel	40 CFR 98 Subpart A
Gas-fired unit	40 CFR 98 Subpart A
Global warming potential or GWP	40 CFR 98 Subpart A
GPA	40 CFR 98 Subpart A
Greenhouse gas or GHG	40 CFR 98 Subpart A
High heat value or HHV	40 CFR 98 Subpart A
High-bleed pneumatic devices	40 CFR 98 Subpart A
Hydrofluorocarbons or HFCs	40 CFR 98 Subpart A
Industrial greenhouse gases	40 CFR 98 Subpart A
Intermittent bleed pneumatic devices	40 CFR 98 Subpart A
Isobutane	40 CFR 98 Subpart A
Isobutylene	40 CFR 98 Subpart A
Low-bleed pneumatic devices	40 CFR 98 Subpart A
Maximum rated heat input capacity	40 CFR 98 Subpart A
MMBtu	40 CFR 98 Subpart A

Table 4-1. List of Definitions from Subpart A and Subpart W. (cont.)

Mscf	40 CFR 98 Subpart A
N ₂ O	40 CFR 98 Subpart A
Natural gas	40 CFR 98 Subpart A
Natural gas driven pneumatic pump	40 CFR 98 Subpart A
Natural Gas Liquids (NGLs)	40 CFR 98 Subpart A
Natural gasoline	40 CFR 98 Subpart A
NIST	40 CFR 98 Subpart A
Oil-fired unit	40 CFR 98 Subpart A
Open-ended valve or lines (OELs)	40 CFR 98 Subpart A
Operating hours	40 CFR 98 Subpart A
Operational change	40 CFR 98 Subpart A
Operator	40 CFR 98 Subpart A
Outer continental shelf	40 CFR 98 Subpart A
Owner	40 CFR 98 Subpart A
Pentanes plus, or C5+	40 CFR 98 Subpart A
Perfluorocarbons or PFCs	40 CFR 98 Subpart A
Petroleum	40 CFR 98 Subpart A
Portable	40 CFR 98 Subpart A
Precision of a measurement at a specified level (e.g., one percent of full scale or one percent of the value measured)	40 CFR 98 Subpart A
Pressure Relief Device or Pressure Relief Valve or Pressure Safety Valve	40 CFR 98 Subpart A
Primary Fuel	40 CFR 98 Subpart A
Process emissions	40 CFR 98 Subpart A
Process unit	40 CFR 98 Subpart A
Process vent	40 CFR 98 Subpart A
Reciprocating compressor	40 CFR 98 Subpart A
Reciprocating compressor rod packing	40 CFR 98 Subpart A
Re-condenser	40 CFR 98 Subpart A
Safety device	40 CFR 98 Subpart A
Sales oil	40 CFR 98 Subpart A
Sensor	40 CFR 98 Subpart A
SF6	40 CFR 98 Subpart A
Shutdown	40 CFR 98 Subpart A
Site	40 CFR 98 Subpart A
Sour natural gas	40 CFR 98 Subpart A
Standard conditions or standard temperature and pressure (STP)	40 CFR 98 Subpart A
Storage tank	40 CFR 98 Subpart A
Supplemental fuel	40 CFR 98 Subpart A

Table 4-1. List of Definitions from Subpart A and Subpart W. (cont.)

Sweet gas	40 CFR 98 Subpart A
Trace concentrations	40 CFR 98 Subpart A
Ultimate analysis	40 CFR 98 Subpart A
United States	40 CFR 98 Subpart A
Valve	40 CFR 98 Subpart A
Vapor recovery system	40 CFR 98 Subpart A
Vaporization unit	40 CFR 98 Subpart A
Wellhead	40 CFR 98 Subpart A
Wet natural gas	40 CFR 98 Subpart A
You	40 CFR 98 Subpart A
Acid Gas	40 CFR 98 Subpart W
Acid gas removal unit (AGR)	40 CFR 98 Subpart W
Acid gas removal vent stack emissions	40 CFR 98 Subpart W
Basin	40 CFR 98 Subpart W
Component	40 CFR 98 Subpart W
Compressor	40 CFR 98 Subpart W
Condensate	40 CFR 98 Subpart W
Engineering estimation	40 CFR 98 Subpart W
Equipment leak	40 CFR 98 Subpart W
Equipment leak detection	40 CFR 98 Subpart W
External combustion	40 CFR 98 Subpart W
Facility (distribution)	40 CFR 98 Subpart W
Facility (onshore production)	40 CFR 98 Subpart W
Farm taps	40 CFR 98 Subpart W
Field	40 CFR 98 Subpart W
Flare combustion efficiency	40 CFR 98 Subpart W
Flare stack emissions	40 CFR 98 Subpart W
Gas well	40 CFR 98 Subpart W
Internal combustion	40 CFR 98 Subpart W
Liquefied natural gas (LNG)	40 CFR 98 Subpart W
Liquefied natural gas (LNG) import and export equipment	40 CFR 98 Subpart W
Liquefied natural gas (LNG) storage	40 CFR 98 Subpart W
LNG boiloff gas	40 CFR 98 Subpart W
Meter, turbine	40 CFR 98 Subpart W
Natural gas distribution	40 CFR 98 Subpart W
Offshore	40 CFR 98 Subpart W
Offshore petroleum and natural gas production	40 CFR 98 Subpart W
Oil well	40 CFR 98 Subpart W
Onshore natural gas processing.	40 CFR 98 Subpart W

Table 4-1. List of Definitions from Subpart A and Subpart W. (cont.)

Onshore natural gas transmission compression	40 CFR 98 Subpart W
Onshore petroleum and natural gas production	40 CFR 98 Subpart W
Onshore petroleum and natural gas production owner or operator	40 CFR 98 Subpart W
Operating pressure	40 CFR 98 Subpart W
Pump	40 CFR 98 Subpart W
Pump seal emissions	40 CFR 98 Subpart W
Pump seals	40 CFR 98 Subpart W
Reservoir	40 CFR 98 Subpart W
Residue Gas	40 CFR 98 Subpart W
Residue Gas Compression	40 CFR 98 Subpart W
Separator	40 CFR 98 Subpart W
Transmission pipeline	40 CFR 98 Subpart W
Turbine meter	40 CFR 98 Subpart W
Underground natural gas storage	40 CFR 98 Subpart W
Vented emissions	40 CFR 98 Subpart W

For Subpart A, see §98.6:

<http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=b5877248c801e284275a70d418e68d87&rgn=div8&view=text&node=40:20.0.1.1.12.1.1.6&idno=40>

For Subpart W, see §98.238:

<http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=b5877248c801e284275a70d418e68d87&rgn=div8&view=text&node=40:20.0.1.1.12.23.1.9&idno=40>

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Volume 5: *Activity Factors* GRI 94/00257.22, EPA -600/R-96-080e

Volume 6: *Vented and Combustion Source Summary* GRI 94/00257.23, EPA -600/R-96-080f

Volume 7: *Blow and Purge Activities* GRI 94/00257.24, EPA -600/R-96-080g

Volume 8: *Equipment Leaks* GRI 94/00257.25, EPA -600/R-96-080h

Volume 9: *Underground Pipelines* GRI 94/00257.26, EPA -600/R-96-080i

Volume 10: *Metering and Pressure Regulating Stations in Natural Gas Transmission and Distribution* GRI 94/00257.27, EPA -600/R-96-080j

Volume 11: *Compressor Driver Exhaust* GRI 94/00257.28, EPA -600/R-96-080k

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APPENDIX A

Petroleum and Natural Gas Systems Industry Borders

Discussion of Borders based on Segments in GHG Mandatory Reporting Rule, Subpart W

A. Commonly Defined Borders for Petroleum and Natural Gas Industry Segments

The natural gas industry extends from the wellhead (i.e. exploration and production) to the burner tip (i.e. distribution to end users). Subpart W of the GHG MRR covers Petroleum and Natural Gas Systems and lists eight industry segments:

- Offshore petroleum and natural gas production;
- Onshore petroleum and natural gas production;
- Onshore natural gas processing plants;
- Onshore natural gas transmission compression;
- Underground natural gas storage;
- Liquefied natural gas (LNG) storage;
- LNG import and export equipment; and
- Natural gas distribution.

All of these segments include GHG emissions associated with natural gas. For the purposes of GHG emission estimates, this appendix defines the borders for these segments with other industries (e.g., electric power generation) and with other oil and gas segments. Some facility definitions for Subpart W reporting do not include all natural gas industry equipment (e.g., natural gas transmission pipelines are excluded from Subpart W reporting); thus, discussion is provided where Subpart W natural gas segment borders differ from traditional industry borders for GHG emissions reporting. For some industry segments (e.g., onshore natural gas processing, onshore natural gas transmission compression, and offshore petroleum and natural gas production), identifying the facility is more straightforward since typically there are physical borders and ownership structures that lend themselves to identifying the scope of reporting and responsible reporting entities. However for other segments this determination is more challenging and will require a case-by-case determination.

Section A-1 defines and discusses natural gas industry borders (e.g. with oil production) and Section A-2 defines and discusses natural gas segment borders (e.g. production, processing, transmission and storage, distribution, and LNG) including a brief discussion of issues associated with co-located or multi-use facilities. To the extent possible, this appendix attempt to delineate physical borders, identify operating activity demarcation and structures, and examine common segment definitions while avoiding double counting. These borders are essential for the purpose of establishing reporting scope and responsible reporting entities.

A-1 Natural Gas Industry Borders

Guidelines from the 1996 GRI/EPA Study “Methane Emissions from the Natural Gas Industry” [GRI 1996] are used for setting the natural gas industry borders for GHG emission estimates.

For oil and gas production, certain oil production equipment is excluded from the natural gas production segment because it exists to produce oil and is not needed for gas production. Figure A-1 shows the general equipment found at an oil well that markets gas and the border for gas industry equipment. Oil wells that market gas primarily exist because they produce oil, and the gas production is secondary and usually generates lower revenue. All equipment at an oil well site is excluded from the natural gas industry unless it is used to collect, process, or transport marketed natural gas. Figure A-2 shows the general equipment found at gas wells. With the exception of equipment used to collect and handle condensate or oil, the gas well equipment is considered part of the gas industry. The following text from Volume 3 of "Methane Emissions from the Natural Gas Industry" [GRI/EPA 1996] provides additional guidance for differentiating oil and gas production equipment and operations.

“the segment definition for gas industry production equipment excludes equipment associated with oil production.

The rationale for defining the borders is that all equipment at a gas well site, except equipment used to collect and handle liquids that are marketed (oil or condensate), is part of the gas industry, but that all equipment at an oil site is excluded unless it is used to collect, process or transport marketed natural gas....

Therefore, the definition excludes all oil tanks and equipment at all oil wells that do not market gas. In addition, it excludes much of the equipment at oil wells that do market gas. At oil wells that market gas, the gas production is secondary and usually generates lower revenue; the well exists primarily because it produces oil. Therefore, the wellhead, the separator, the pneumatic control valves, the well’s chemical injection pumps, any field use gas lines, and all of the liquid pumping are considered part of the oil industry The gas industry equipment begins only on the gas line downstream of the separator, at the first piece of gas line equipment, such as the sales meter, compressor, or dehydrator.

Oil wells that market gas ... will always have a separator and a meter. ...they may or may not have a dehydrator or compressor, depending on the absorbed moisture content and the pressure.

Oil wells that market gas may either be free-flowing or artificial lift wells. Free-flowing wells often have absorbed or co-produced gas that is marketed. Therefore, some of the equipment at these free-flowing oil wells is considered part of the gas industry if it exists to market the gas. Artificial-lift wells are most often not part of the gas industry, but a few do produce gas and therefore are included in the gas industry definition.

Artificial-lift oil wells that have downhole pumps or surface pump jacks usually do not produce or market any gas and are therefore not part of the gas industry. Artificial-gas lift oil wells push compressed gas downhole and inject the gas into the tubing, thus using the gas to aerate the oil in the tubing string. This brings the oil back to the surface. Only the gas-lift wells that produce and market gas in excess of the amount injected are considered part of the natural gas industry. For

gas-lift oil wells that market gas, the compressors associated with the gas-lift circulation are not considered to be part of the gas industry.”¹

Natural gas processing plants recover high value liquid products from the inlet gas stream and maintain residue gas properties (e.g. gas content and heating value). Figure A-3 is a gas plant schematic. Liquid products – propane, butane, natural gas liquids – and sometimes ethane are recovered by absorption or compression and cooling processes.

“A gas plant may have fractionation towers and stabilization towers to further purify the individual components of the product stream. The back end of the gas plant, such as the fractionation train, is *excluded* [emphasis added] from the gas industry definition since it exists to purify and market liquid products. The back end of the gas plant has negligible methane emissions since the liquids handled contain only trace amounts of methane. The front end of the gas plant often contains dehydration facilities, wet gas compression, and the absorption or compression and cooling processes. All gas plants are considered part of the natural gas industry.”²

For gas transmission companies that transfer gas to end users through farm taps or direct industrial sales lines, all equipment up to and including the customer meter are included in the natural gas industry. The natural gas industry border occurs at the customer meter (custody transfer); end user piping, combustion, and vented emissions are not included. Gas transmission companies typically receive natural gas from processing plants, and onshore and offshore production.

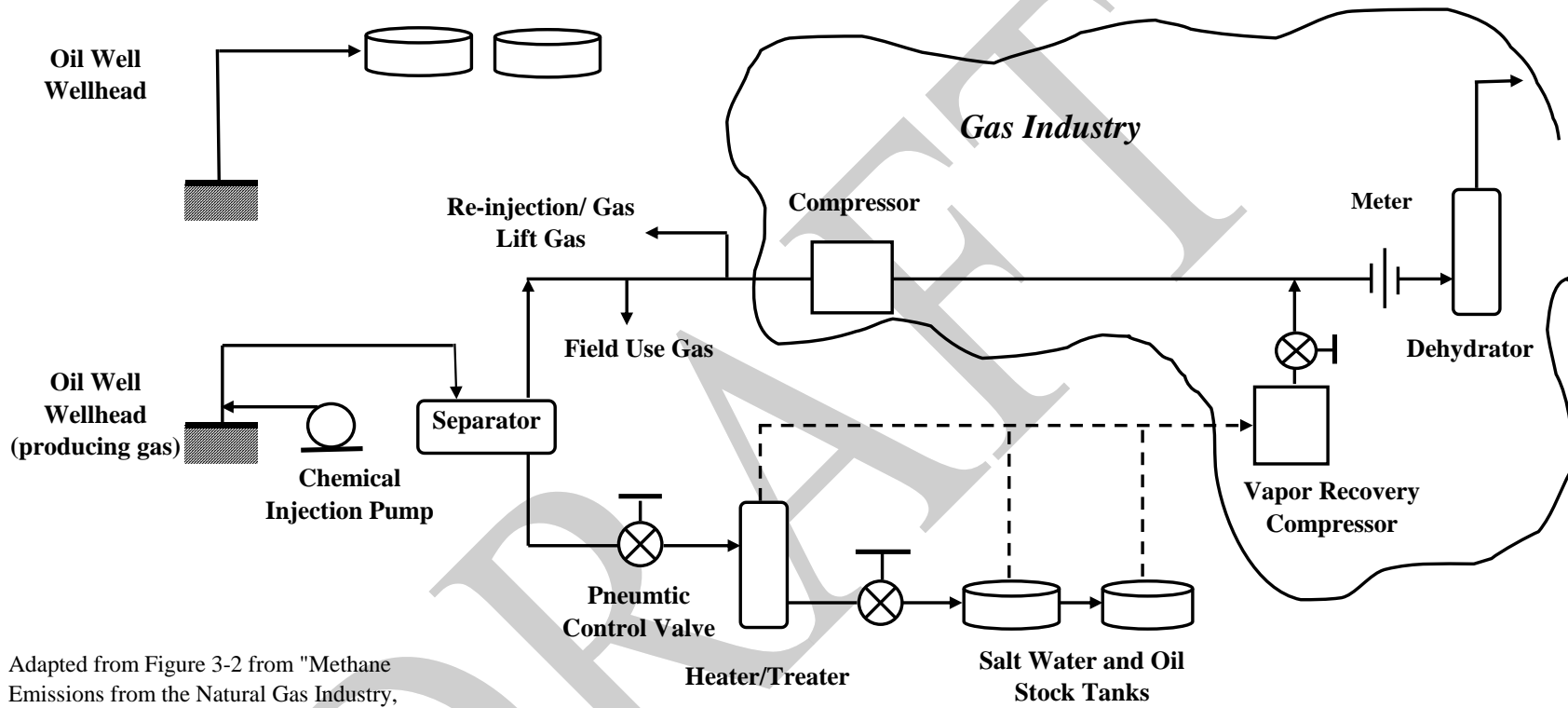
For LNG import and export facilities, the natural gas industry border is at the point of custody transfer. For LNG import, custody transfer occurs as the LNG is transferred from the transport vessel/LNG carrier to the import facility/receiving terminal. For LNG export, custody transfer occurs as the LNG is transferred to the transport vessel/LNG carrier from the export facility. At some loading terminals, custody transfer employs coriolis mass flow meters and ultrasonic flow meters while carrier tank volume measurements are also used.³

For gas distribution companies that deliver gas to end users, all equipment up to and including the customer meter are included in the natural gas industry. The natural gas industry border is at the customer meter; end user piping, combustion, and vented emissions are not included.

¹ Methane Emissions from the Natural Gas Industry, Volume 3, page 6 [GRI/EPA 1996]

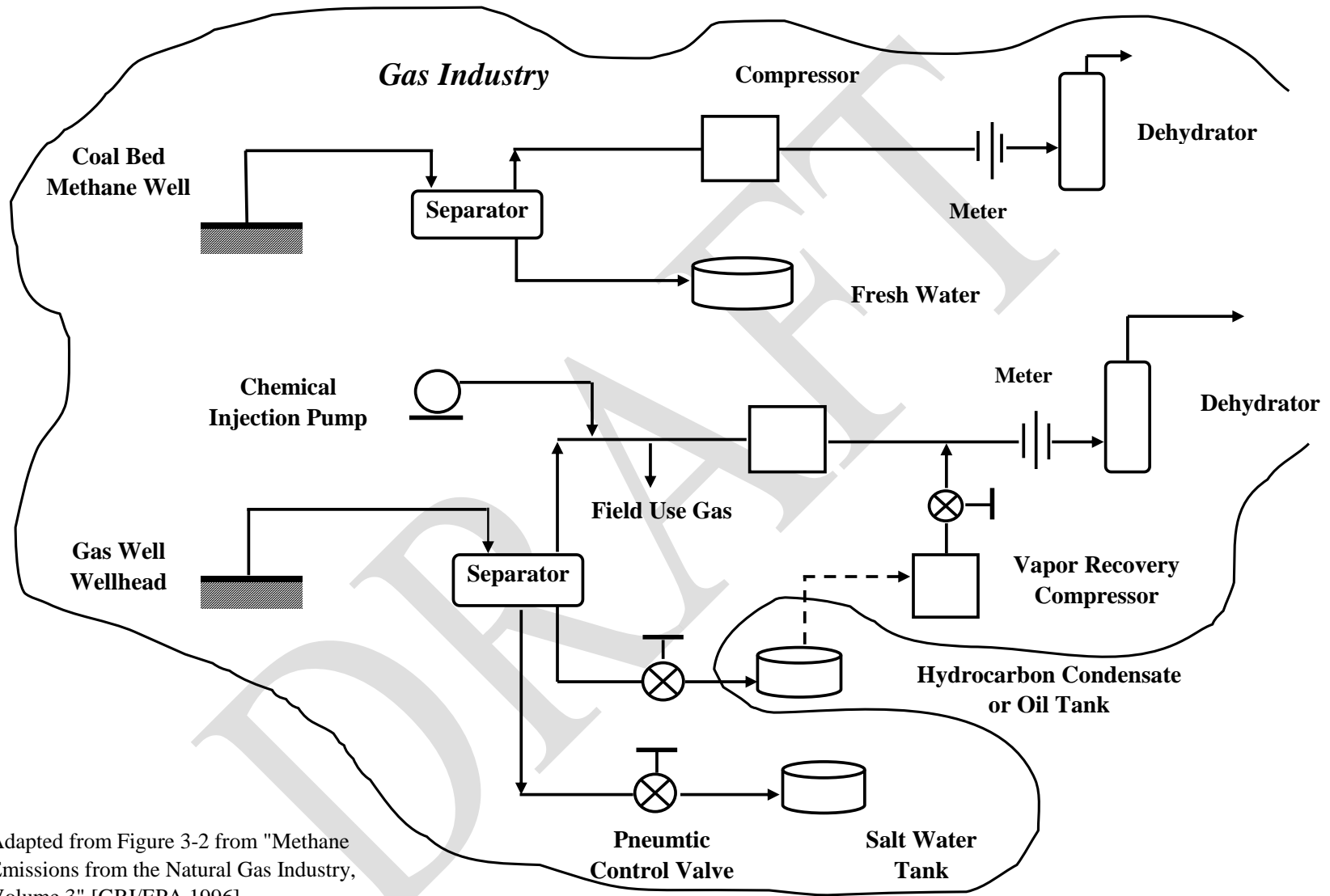
² Methane Emissions from the Natural Gas Industry, Volume 3, page 10 [GRI/EPA 1996]

³ GIIGNL (Groupe International des Importateurs de Gaz Naturel Liquéfié) LNG Custody Transfer Handbook



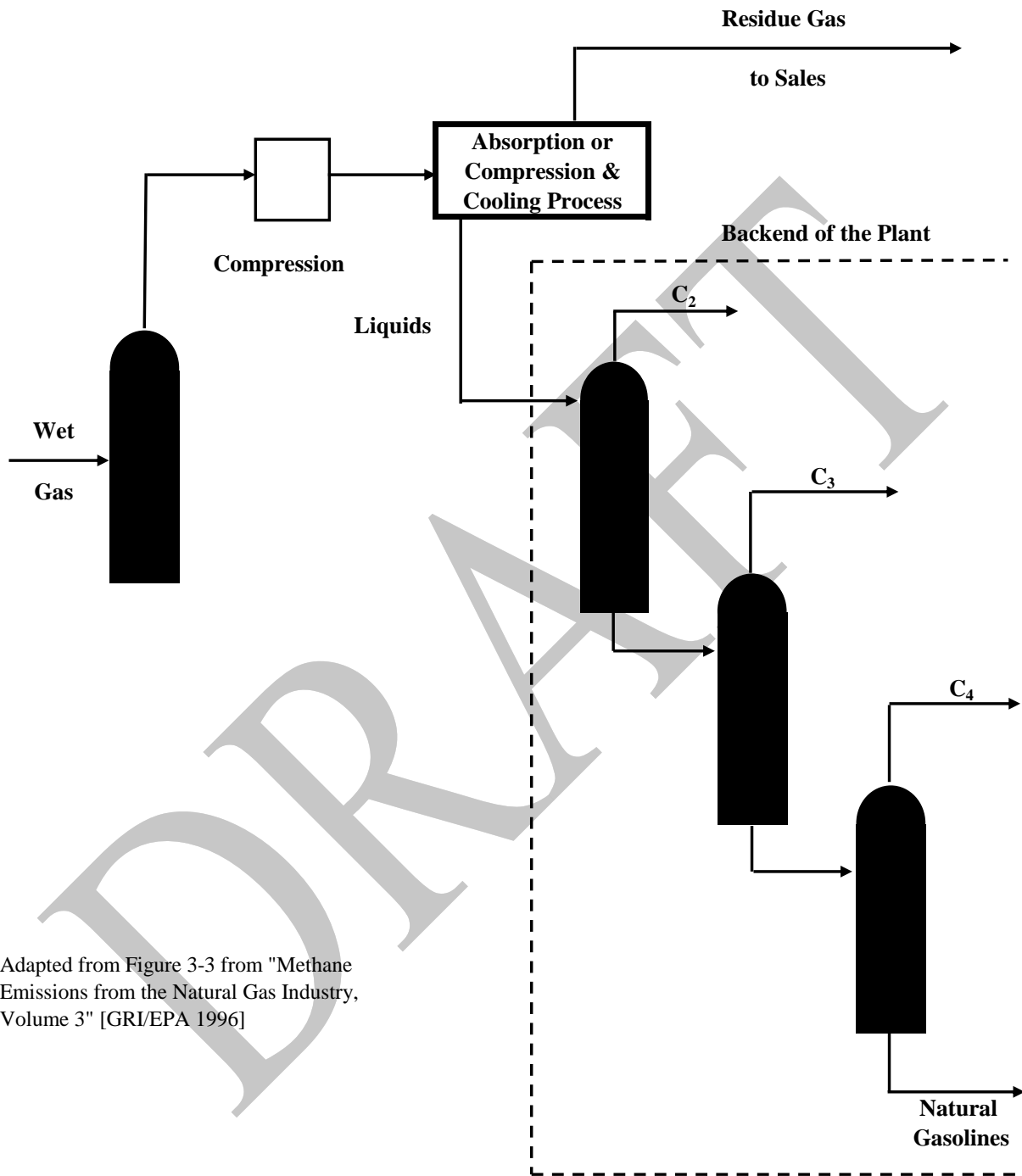
Adapted from Figure 3-2 from "Methane Emissions from the Natural Gas Industry, Volume 3" [GRI/EPA 1996]

Figure A-1. Gas industry border at oil production wells that market gas.



Adapted from Figure 3-2 from "Methane Emissions from the Natural Gas Industry, Volume 3" [GRI/EPA 1996]

Figure A-2. Gas industry border at gas production wells.



Adapted from Figure 3-3 from "Methane Emissions from the Natural Gas Industry, Volume 3" [GRI/EPA 1996]

Figure A-3. Gas processing plant with natural gas industry border at backend of the plant.

A-2 Natural Gas Segment Descriptions and Borders

Figure A-4 shows the primary GHG emitting equipment and operations for the eight industry segments required to report GHG emissions under Subpart W of the GHG Mandatory Reporting Rule. Segment borders are typically at a point of custody transfer; for example, City Gates metering and regulatory (M&R) stations associated with the addition of odorant (e.g. mercaptans) are the typical borders for the Transmission and Distribution segments. This figure also shows the typical segment borders but does not necessarily consider all segment borders; for example, a processing plant could deliver gas directly to a Distribution company. The following subsections provide additional detail regarding the equipment and operations, and borders for each segment. The first paragraph in each section is the segment description from Subpart W. Additional discussion and detail are then provided.

A-2.1 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.” [§98.230(a)(1)]

For Subpart W, estimates of offshore production GHG emissions are based on MMS GOADS reporting. GHG emission sources required to report to MMS GOADS include reciprocating engines and gas turbines (gas-, diesel-, and gasoline-fired), other combustion sources (flares, and boilers and heaters), drilling operations, loading operations, gas treatment, storage tanks, pneumatic devices, cold vents, and fugitive sources. For natural gas, this segment typically borders with gas processing or gas transmission, depending on the gas quality. The segment border is defined as the custody transfer point from the offshore platform(s) to the gas transmission or processing entity.

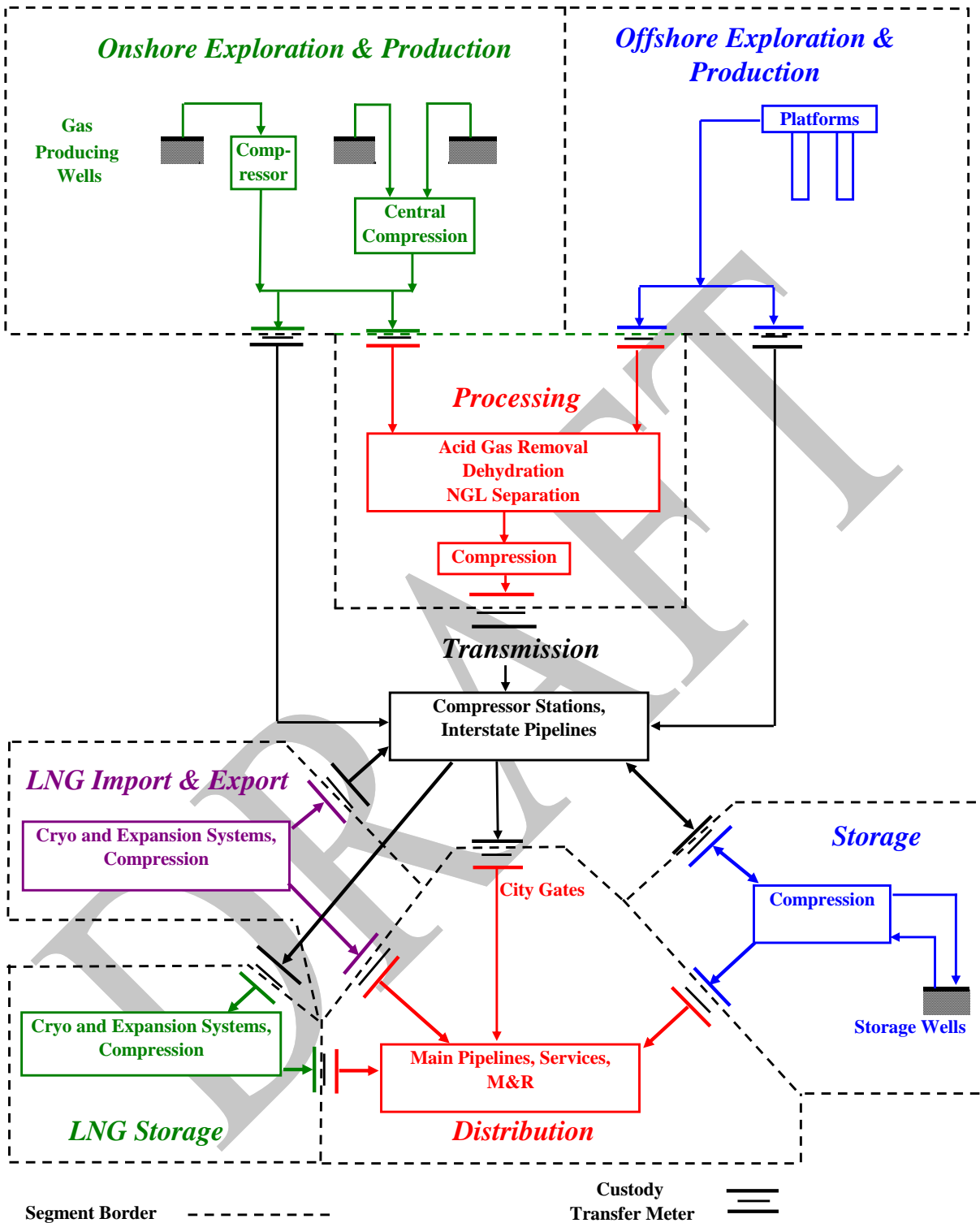


Figure A-4. Typical natural gas industry segment borders, and primary equipment and operations.

A-2.2 Onshore petroleum and natural gas production.

“Onshore petroleum and natural gas production means all equipment on a well pad or associated with a well pad (including compressors, generators, or storage facilities), and portable non-self-propelled equipment on a well pad or associated with a well pad (including well drilling and completion equipment, workover equipment, gravity separation equipment, auxiliary non-transportation-related 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 and all enhanced oil recovery (EOR) operations using CO₂, and all petroleum and natural gas production located on islands, artificial islands, or structures connected by a causeway to land, an island, or artificial island.” [§98.230(a)(2)]

For natural gas, this segment typically borders with gas processing or gas transmission, depending on the gas quality. The segment border is defined as the custody transfer point to the gas transmission or processing entity. Subpart W currently does not include reporting of emissions from gathering lines and boosting stations (i.e. gas gathering/central compression); these sources could be addressed in the future by a rule revision. Generally, gathering lines and boosting stations are included in the onshore production segment.

A-2.3 Onshore natural gas processing plants

“Natural gas processing separates and recovers natural gas liquids (NGLs) and/or other non-methane gases and liquids from a stream of produced natural gas using equipment performing one or more of the following processes: oil and condensate removal, water removal, separation of natural gas liquids, sulfur and carbon dioxide removal, fractionation of NGLs, or other processes, and also the capture of CO₂ separated from natural gas streams. This segment also includes all residue gas compression equipment owned or operated by the natural gas processing facility, whether inside or outside the processing facility fence. This source category does not include reporting of emissions from gathering lines and boosting stations. This source category includes:

- (i) All processing facilities that fractionate.
- (ii) All processing facilities that do not fractionate with throughput of 25 MMscf per day or greater.” [§98.230(a)(3)]

Gas processing plants typically receive field gas from onshore and offshore production as discussed above. This segment typically transfers gas to gas transmission and the segment border is defined as the custody transfer point to the gas transmission entity. For operations where the processing plant sends natural gas directly to a distribution company or an end user, the custody transfer point determines the segment border. In addition, as discussed in section 3.1, the gas plant back end, such as the fractionation train, is excluded from the gas industry definition since it exists to purify and market liquid products.

Natural gas liquids straddle plants are gas processing plants located on or near a gas transmission line which remove trace NGLs from pipeline quality sales gas and return the sales gas to the transmission line. These plants are considered processing segment facilities with the custody transfer points to and from the transmission pipeline determining the segment borders.

A-2.4 Onshore natural gas transmission compression

"Onshore natural gas transmission compression means any stationary combination of compressors that move natural gas at elevated pressure from production fields or natural gas processing facilities in transmission pipelines to natural gas distribution pipelines or into storage. In addition, transmission compressor stations may include equipment for liquids separation, natural gas dehydration, and tanks for the storage of water and hydrocarbon liquids. Residue (sales) gas compression operated by natural gas processing facilities are included in the onshore natural gas processing segment and are *excluded* from this segment. This source category does not include reporting of emissions from gathering lines and boosting stations – these sources are currently not covered by subpart W." [§98.230(a)(4)]

In addition to the equipment and operations listed in the Subpart W definition, the gas transmission segment includes metering stations (such as farm taps) and the gas transmission pipelines which are used to transfer natural gas across long distances. Subpart W does *not* require reporting of emissions from transmission pipelines and metering stations.

As discussed above, gas transmission companies typically receive natural gas from processing plants, and onshore and offshore production. LNG import terminals and underground storage facilities can also provide gas to transmission pipelines. Gas is typically transported to gas distribution, underground storage, LNG storage, and LNG export facilities and the segment border is defined as the custody transfer point. For transmission-to-distribution transfer, City Gates metering and regulatory (M&R) stations associated with custody transfer and the addition of odorant (e.g. mercaptans) are the typical borders.

The use of custody transfer to define the segment borders is consistent with current regulation. From 40 CFR 63 Subpart HH "NESHAP for Oil and Natural Gas Production Facilities"

"natural gas enters the natural gas transmission and storage source category after the natural gas processing plant, when present. If no natural gas processing plant is present, natural gas enters the natural gas transmission and storage source category after the point of custody transfer."

It should be noted that W is a stand alone rule independent of all other regulations; for example, the facility definitions for onshore production and distribution differ from the traditional CAA rule facility definition, are unique to Subpart W, and do not apply to any other CAA regulation. The HH segment border definition is presented to provide further clarification and note consistency.

A-2.5 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.” [§98.230(a)(5)]

Gas storage facilities primarily receive natural gas from transmission pipelines during periods of low gas demand and return the gas to the pipeline when gas demand increases. Some storage systems provide some low pressure gas directly to distribution systems. The segment borders for these gas flows is the custody transfer point.

A-2.6 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.” [§98.230(a)(6)]

LNG storage facilities primarily receive natural gas from transmission pipelines during periods of low gas demand and return the gas to the pipeline when gas demand increases. Some storage systems provide low pressure gas directly to distribution systems. The segment borders for these gas flows is the custody transfer point.

A-2.7 LNG import and export facilities

“LNG import equipment means all onshore or offshore equipment that receives imported LNG via ocean transport, stores LNG, regasifies 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.” [§98.230(a)(7)]

LNG import facilities receive LNG from LNG carriers and vaporize the natural gas for input to transmission pipelines and distribution systems. There is currently one operating LNG export facility in the United States in Kenai, AL which receives natural gas from local production fields via pipeline. The segment borders for these gas flows is the custody transfer point. In addition, as discussed in section A-1, custody transfer occurs to and from ocean vessels and provides a logical border for the gas industry.

A-2.8 Natural Gas Distribution

“Natural gas distribution means the distribution pipelines (not interstate transmission pipelines or intrastate transmission pipelines) and metering and regulating equipment at city gate stations, and excluding customer meters, that physically deliver natural gas to end users and is operated by a Local Distribution Company (LDC) 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 excludes customer meters and 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.” [§98.230(a)(8)]

As discussed above, natural gas distribution facilities receive natural gas from transmission pipelines, underground storage facilities, and LNG storage. The segment borders for these gas flows is the custody transfer point.

A-3 Multi-Purpose and Co-Located Facilities

For some natural gas equipment and operations at “multi-purpose” facilities – i.e., where multiple Subpart W segment facilities are co-located, defining the industry segment or determining the equipment and sources to report is not always straightforward. Terms such as common ownership, common control and contiguous or adjacent are used to assist in determining whether a single or multiple facility segment reporting is required. EPA has provided inconsistent feedback on defining sources to report and that issue should be addressed soon as Subpart W reporting is implemented.

Where a piece of equipment serves a dual purpose, such as a transmission compressor that also can operate as a gas storage compressor, the GHG reporting rule indicates this piece of equipment should be reported under the majority use industry segment. EPA concluded that most of the potential dual-purpose equipment will have the same emissions reporting requirements in either industry segment, so reporting under only one majority use segment will avoid double counting. EPA recognizes that not all emissions are reported for each segment, such as emissions from a dehydrator located at a compressor station or storage facility. In general, Subpart W attempts to capture the emission sources for each segment that comprise at least 85% of the GHG emissions for the particular segment.

EPA provides the following example: some data may not be reported where the obvious industry segment (e.g., processing facility) has one or a few producing wells inside the facility fence and the processing facility owner/operator does not have enough production emissions in the basin surrounding the processing facility to meet the reporting threshold under onshore production. However, the implications for co-located *facilities*, where multiple facilities from more than one segment are located within common or shared boundaries, are not straightforward. Those situations need to be considered on a case-by-case basis.