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Mitigating Methane Emissions from the Oil and Gas Industry
Model Regulatory Framework

This model framework discusses key sources and control measures for methane emissions from oil and gas operations. Some issues for authorities to consider when establishing regulatory approaches are also provided where relevant. While this model focuses on upstream operations, many of the mitigation measures could be applicable to emission sources in other segments of the natural gas value chain such as distribution and storage.

The model contemplates regulations that seek to achieve the following policy objectives:

- Apply to both upstream oil and gas sources,
- Apply to both new and existing facilities,
- Seek meaningful emission reduction outcomes,
- Based on sound science,
- Cost-effective and flexible to allow for future technological developments,
- Seek to stimulate innovation,
- Establish transparency, and
- Drive continuous improvement.

Effective regulation of methane emissions from upstream oil and gas operations should minimize emissions from three basic source categories:

1. "Fugitive" emissions from equipment and components, e.g., leaks or excessive emissions due to equipment malfunction;
2. Well head operations that result in venting; and
3. Equipment that emits gas as part of normal operations.

Considerable emissions mitigation can also occur through the design of new facilities and operations to minimize emission sources (e.g., fewer flanges, fewer tanks, lower emitting pneumatic controllers, etc.).

Additionally, reasonable information gathering, recordkeeping and reporting to regulatory agencies help to support compliance enforcement, ensure environmental performance and provide information to policymakers and other stakeholders.

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1. Leak Detection and Repair Program (regulatory purpose: find and repair leaks)

Regulated Item	Description	Regulatory Practice / Control

Component and Equipment Leaks	Unintentional emissions, or leaks, of gas can occur from equipment and processes across oil and gas infrastructure. Typical equipment components where fugitive emissions can occur are valves, screwed connections, flanges, open-ended lines and pump seals.	• Establish a "leak detection and repair" (LDAR) program
		• Leaks detected should be repaired when possible, or entered into a system for correction as soon as practicable (e.g., within 30 days)
		• LDAR coverage should be repeated periodically (e.g., at least once per year)
		• A regulating authority should also consider whether to:
		  • Provide exemptions for low producing or "marginal" wells (e.g., less than 15 BOE per day)
		  • Develop a specific listing of equipment and components to be covered

2. Wellhead Activities (regulatory purpose: minimize flowback venting)

Regulated Item	Description	Regulatory Practice / Control
Completions of Hydraulically Fractured Wells	Hydraulic fracturing involves pumping water and proppants (normally sand) into a shale formation in order to "crack" the rock and release the oil or gas, with the proppants holding open the cracks. After this occurs, the well is "completed" by allowing the water and excess proppant to flow back out of the well to clear out the wellbore for production. During this period, the flowback can be mixed with natural gas that can vent to the atmosphere if not controlled.	• New hydraulically fractured wells should follow reduced emissions completion (REC) procedures • REC separators should be used so the gas can be routed for separate collection and into sales lines or other production uses, once conditions allow • Collected gas can be combusted if other uses are infeasible, or for safety reasons
Manual Liquids Unloadings	In gas wells, small amounts of liquids present in the formation will flow out of the wellbore along with the gas. Over time, as pressure rates decline, these liquids will accumulate in the wellbore and eventually impede the flow of gas out of the well to the sales line. Various techniques to remove or "unload" the liquids exist. Manual liquid unloadings involve shutting off the sales line and diverting the gas to a less pressurized environment, which allows the formation pressure to carry the liquids out of the well along with the gas. This practice generally results in some direct venting of methane into the atmosphere.	• Manual liquid unloadings from wells should be monitored by personnel who remain within near proximity during the process to minimize venting as much as possible

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3. Operational Equipment Controls (regulatory purpose: minimize excessive venting)

Regulated Item	Description	Regulatory Practice / Control
Pneumatic controllers	Pneumatic controllers are valves that are used throughout industry operations to control pressure, fluid levels, temperature, flow rate and other processes automatically. Natural gas powered pneumatic controllers directly release or "bleed" gas (methane) as part of their intended functioning. There are generally three types of venting pneumatic controllers: • Continuous "high" bleed, that vent constantly; • Continuous "low" bleed, that vent constantly at a lower rate; and • Intermittent vent, that release gas only when actuating to perform its process control (the timing of which can vary from hours to months) No bleed and air-driven controllers also exist, but are not viable in many applications. Pneumatic devices can also leak methane due to equipment malfunction.	• Eliminate the use of continuous high bleed pneumatic (HBP) control devices (except where process or safety conditions require) • Replace HBPs on existing facilities • A regulating authority should consider an appropriate phase out period given its operational context (e.g., within 3 years) • Do not use HBPs on new facilities • Use no or low bleed devices where technically feasible • Use mechanical or electric control where possible when electricity is available • Conduct periodic pneumatic controller maintenance (physical checks), for example when conducing LDAR program
Pneumatic pumps	Pumps are used to inject chemicals into wells and pipelines to maintain effective operations. Natural gas driven pumps are used when no electricity is available.	• Direct vented gas to vapor recovery unit (VRU) systems with the gas directed to productive usage onsite (e.g. sales), or to combustion if feasible • Install electric pumps (including solar electric)
Compressors – centrifugal	Oil and gas operations rely on pressure in piping to move the resource through systems. Compressors are used to create and maintain that pressure. Centrifugal compressors can have "wet" or oil-based seals that can result in emissions when the oil sealant becomes gasified and the gas must be purged to maintain effectiveness.	• When degasifying the seal oil, route the gas to a VRU or to a control device • Replace wet seals with dry seals where feasible
Compressors – reciprocating	Reciprocating compressors have piston rods and casings that emit some gas during normal operation, and can degrade over time.	• Replace piston rod packing components on a regular basis (e.g., every three years or 26,000 hours of operation, whichever comes first)
Storage Vessels (Permanent Stationary Tanks)	Storage vessels are used in many aspects of operations, for example in storing oil, condensate, or produced water. These vessels, or tanks, can be isolated or grouped together in a "tank battery" depending on the operational context and need for storage of the various products. Vapor gas from the stored material can be emitted through the tank pressure relief equipment.	• Route gas to a capture system (e.g. a vapor recovery unit or VRU) for beneficial use to achieve at least a 95% reduction in methane emissions, or • Route gas to a flare or control device to achieve at least a 95% reduction in methane emissions. • A regulating authority should evaluate the use of VRU technology where gas availability is in sufficient quantities (and meets sales quality) to sustain VRU operations. VRU evaluations must also assess process safety constraints as well as available area or region gas takeaway capacity.
Transmission Pipeline Blowdowns between Compressor Stations	Blowdown means the release of gas from a pipeline or section of pipeline that causes a reduction in system pressure or a complete depressurization. Typically required to clear and depressurize piping for maintenance activities.	• Route gas to a compressor or capture system for beneficial use, or • Route gas to a flare, or • Route gas to a low-pressure system by taking advantage of existing piping connections between high- and low-pressure systems, temporarily resetting or bypassing pressure regulators to reduce system pressure prior to maintenance, or installing temporary connections between high and low-pressure systems, or • Utilize hot tapping, a procedure that makes a new pipeline connection while the pipeline remains in service, flowing natural gas under pressure, to avoid the need to blow down gas.
Incomplete combustion (including associated gas flaring)	Methane emissions can result from the incomplete combustion of natural gas, for example from gas engines or associated gas flaring, with the uncombusted natural gas being emitted in the exhaust stream.	• Optimize engine/turbine combustion efficiency • Improve combustion efficiency of flares (e.g., change flare tips, install flare ignition systems); consider means to Increase gas utilization versus combustion.

4. Record Keeping and Reporting

Regulated Item	Record Keeping and Reporting
LDAR Program	Document and annually report results of inspections • Dates of inspections and operations covered • Number of leaks identified, by component • Dates of repairs made
Completions Flowback	• Report to agency the anticipated dates of upcoming completions, within two days of each process, to allow opportunity for direct inspection • Document and report annually the locations, dates, times of completions, and the durations of any venting that occurred during flowback
Manual Liquid Unloadings	Document and report annually dates, times, durations and estimated volumes of any venting that occurred
Pneumatic controllers	• Document and annually report the type and bleed rates of pneumatic controllers the company has in operation • Number of high bleed pneumatics and dates they are replaced • Documentation that the devices are performing properly (not venting when idle) • Monitor, document and annually report on pneumatic controllers as part of LDAR program
Pneumatic pumps	Monitor, document and annually report on pumps, VRUs and combustion devices as part of LDAR program
Compressors – centrifugal	Monitor, document and annually report on compressors, wet seals, VRUs and combustion devices as part of LDAR program
Compressors – reciprocating	• Monitor, document and annually report on compressors, seals, rod packing, VRUs and combustion devices as part of LDAR program • Document and annually report on piston rod packing component replacement according to regulatory schedule (e.g., every three years or 26,000 hours of operation)
Storage Vessels (Tanks)	• Document installation and proper operation of gas capture systems as regulatory required (e.g. a VRU or combustion device) for storage vessels, for beneficial use to achieve at least a 95% reduction in methane emissions, or • Monitor, document and annually report on storage vessels as part of LDAR program
Transmission Pipeline Blowdowns between Compressor Stations	• Document and report annually on the number of blowdown events, as well as the estimated volume of gas emitted from such events
Total Methane Emissions	Each operator should report annually the total methane emissions from its operated assets.