



Natural Gas STAR Methane Challenge Program

Continuous Improvement Update

Finalizing an Equipment Leaks/Fugitive Emissions Commitment Option for Compressor Isolation and Blowdown Valve Leakage

Proposed by: Natural Gas STAR Methane Challenge Program in coordination with National Fuel Gas

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Category of change: Finalizing a new BMP commitment option

Summary of change: Develop a commitment option for mitigating methane emissions from leaking isolation and blowdown valves on compressors

Overview

Through the Natural Gas STAR Methane Challenge Program (“the Program”), EPA encourages Partners to make ambitious commitments to reduce natural gas (methane) emissions through broad scale implementation of cost-effective technologies and practices. EPA recognizes ongoing advances in technologies and approaches for identifying, measuring, and mitigating methane emissions and will consider creating new commitment options, as well as revising approaches to track, implement, and report on current commitments through the Continuous Improvement Process.¹

When the program was launched in 2016, EPA identified four emission sources that were of interest to partners, but for which commitment options were not yet ready to be finalized in the Best Management Practice (BMP) Commitment Option. Equipment leaks/fugitive emissions was one of these four sources. In this document, the Program establishes a best management practice to address a specific subset of this category: isolation and blowdown valve leakage. This comprises an initial, compressor station-related fugitive emissions commitment option. The following sections outline the emission source and options for voluntarily mitigating methane emissions and tracking reductions from this source. This includes specifying data elements that will be collected to track commitment progress.

¹ Details available on the Program website at <https://www.epa.gov/natural-gas-star-program/methane-challenge-continuous-improvement>

While this program update focuses on a specific subset of equipment leaks, the Program could later expand the scope of the Equipment Leaks/Fugitive Emissions source (i.e., beyond compressor valve leakage) as well as evaluate options for upstream segments.

Notice and Disclaimer

This document provides an overview of a best practice for reducing methane emissions from leaking isolation and blowdown valves on compressors through maintenance, monitoring, and valve repair/replacement. Partner companies that commit to mitigate emissions from this emission source can use this information to better understand options available for mitigating emissions from these sources. Each facet of the best practice may not be suited for a piece of equipment and/or facility, so application must be determined on a site-specific basis. Information in this document is not official guidance; rather, it provides general information about addressing methane emissions from leaking isolation and blowdown valves on compressors. Partner companies are responsible for compliance with applicable regulations.

Emission Source

For the purposes of this document, compressor components include those physically connected to or immediately adjacent to a compressor. Compressor blowdown valves, unit isolation valves, and seals (i.e., reciprocating compressor rod packing and centrifugal compressor wet or dry seals) are identified as “major” compressor components. Non-compressor components are all other components at a compressor station. Seals are already addressed in the Methane Challenge Best Management Practice Commitment Option and related Technical Document and will not be discussed further in this document. This program update addresses methane emissions at compressor stations from leakage through compressor blowdown and isolation valves.

Compressor Mode of Operation

When a compressor is in a not-operating depressurized (NOD) mode, gas may leak to atmosphere via unit isolation valves. In this NOD configuration, the isolation valves are closed against both high-pressure suction and discharge pipeline gas and the exterior and elevated blowdown valve(s) is open. If through-valve leakage is present on the isolation valves, the gas is typically routed via a vent line and through an open blowdown valve(s), which is open to atmosphere. Figure 1 is a simple schematic of such a leak. Such leaks, which are considered “elevated vent sources,” can be visualized using optical gas imaging (i.e., an OGI camera).

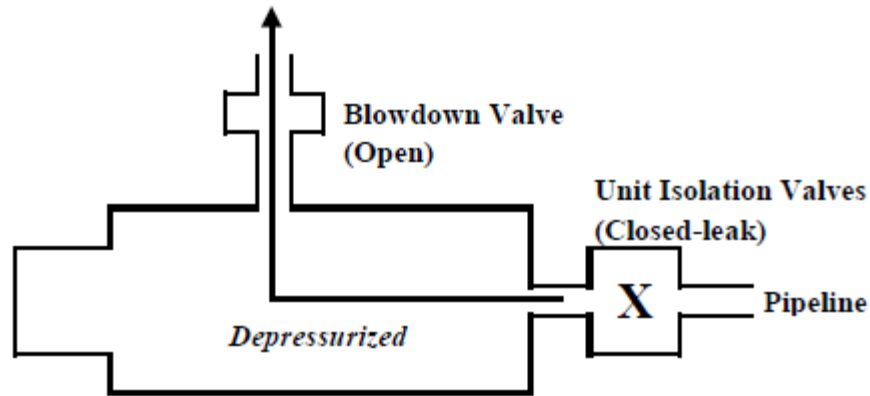


Figure 1. Unit Isolation Valve Schematic

Often, compressors have multiple isolation valves that exhaust through-valve leakage to atmosphere through a common vent. With such configurations, methods are needed to identify specific valves contributing to through-valve leakage and quantify the relative leak rates when more than one valve is leaking. The presence of ice and condensation on or near a valve² is a common method to identify a leaking isolation valve; however, not all leaking valves cause ice formation or condensation. Even when such identification is possible, it does not provide a means to quantify the through-valve gas leak rate. Similarly, when a compressor is operating or in standby-pressurized mode, the isolation valve is open, the blowdown valve is closed, and potential blowdown valve leakage is typically conveyed to atmosphere through the vent (See Figure 2).

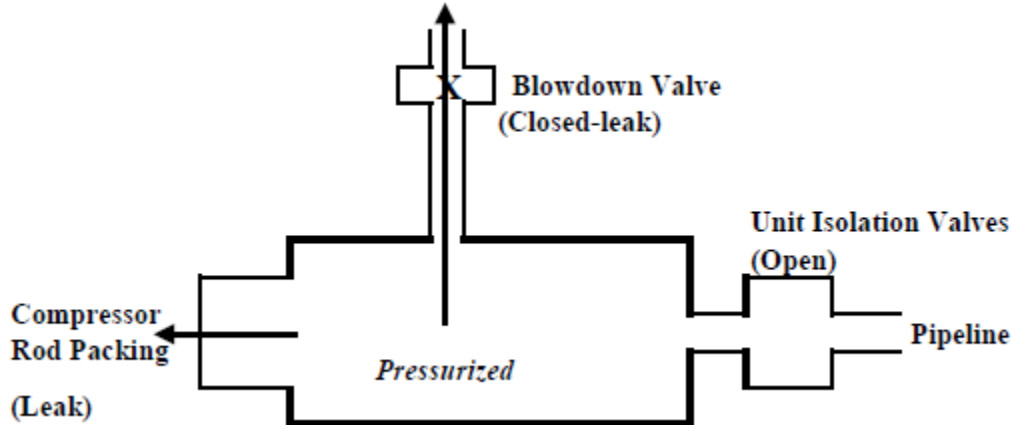


Figure 2. Unit Blowdown Valve Schematic

The operating mode highlighted in Figure 2 presents another potential leak scenario: compressor rod packing. As previously noted, compressor rod packing is addressed in another Methane Challenge BMP and will not be discussed further.

² Presence of ice and condensation is caused by the Joule-Thomson effect; i.e., temperature drop across a leaking valve.

Best Management Practice (BMP) to Address Isolation and Blowdown Valve Leakage

The isolation and blowdown valve performance improvement BMP is primarily designed to address: (1) methods to identify and measure through-valve leakage; (2) maintenance and repair practices for isolation and blowdown valves; (3) compressor station design considerations to facilitate access to isolation and blowdown valves for maintenance, repair, and replacement; (4) isolation and blowdown valves that are less prone to through-valve leakage; and (5) leaking isolation and blowdown valve repair or replacement decision guidelines (e.g., estimate emission reductions for different isolation and blowdown valve repair/replacement options and define what constitutes an actionable leak using valve repair/replacement cost estimates).

As with all Methane Challenge commitments, it is expected that this BMP will be applied across all assets in a partner's operations.

Within 5 years of committing to this emission source, partners will:

- Implement an annual isolation and blowdown valve leak survey at all compressor stations
 - The surveys can be conducted on the compressors as found (i.e., if the compressor is in operating mode or standby-pressurized mode, the blowdown valve will be surveyed and if the compressor is in not-operating-depressurized mode, the isolation valve will be surveyed). However, partners are encouraged to work up to a biannual (or more frequent) survey, timing the surveys so both the isolation and blowdown valve can be surveyed on each unit, each year.
- Develop an isolation and blowdown valve enhanced maintenance plan
 - Partners may create a plan for each compressor station, or they can create a general maintenance plan that they then tailor to each facility to account for pressure, valve types, station operating time, facility configuration, etc.
 - The “enhanced” maintenance plan should be a data-driven “living document”—that is, the plan should be periodically assessed/updated if needed after evaluating valve performance over the course of the commitment. Maintenance activities in this plan will likely go beyond routine/required maintenance.
- Mitigate emissions, where practical, from all detected leaks by any combination of the following:
 - Implementing activities identified in the enhanced maintenance plan that lead to emissions reductions.
 - Repairing or replacing valves where practical (e.g., considering budgetary constraints, operating requirements and maintenance schedules). Repair/replacement should be targeted as soon as practical, but in no more than one to three years after identifying the leaking component.³
 - Routing isolation and blowdown valve leakage to a capture system for beneficial use to achieve at least a 95% reduction in methane emissions.

³ Operational issues such as the need for system/facility blowdown, scheduled outages for maintenance, parts/large valve availability, availability of repair personnel, etc. can be considered when determining the valve repair/replacement schedule.

- Routing isolation and blowdown valve leakage to flare or control device⁴ to achieve at least a 95% reduction in methane emissions.

As part of the annual leak survey, the following data should be documented:

- Leak rate
 - Methodologies from Subpart W of the GHG Reporting Program (40 CFR, Part 98) will be used for leak rate measurement. Note: the acoustic device cannot be used for the purposes of measuring leak rates for this commitment option.⁵
 - Partners will be able to report multiple measurements per year to Methane Challenge if they survey a component more than once a year.
 - If a valve is repaired or replaced, Partners should take a measurement on the unit within 90 days after the repair/replacement to calculate annual emission reductions.
- All survey, maintenance, repair, and replacement data
 - This should include the repair/replacement status of all leaks, as well as information on replacement valves' performance, installation, and design considerations.

Data collected and lessons learned by partners in the first five years of this commitment will be evaluated and used to further refine the parameters of this Methane Challenge commitment option. In the last year of a partner's initial commitment (typically five years after making the commitment), EPA will request a summary report including:

- A discussion of "lessons learned"
- An analysis of leak counts and distribution
- Year-over-year leak changes, repair methods, and practices, including a discussion of the effects of implementing the maintenance plan
- Equipment / valve-specific recommendations
- Maintenance plan results and costs

Reporting Approach

When a leak is identified, measurement will be completed using Subpart W approved methods.

Measurements will be completed before and after valve repair or replacement. These measurements will allow for quantification of emission reductions. The unit should be measured within 90 days of repair or replacement for the purposes of calculating an emission reduction.

If partners did not complete repair or replacement on a given component, but did implement enhanced maintenance, partners may complete periodic measurements to determine if more frequent/targeted valve maintenance reduced emissions.

Subsequent measurements will provide insight into leak recurrence, performance characteristics for different valve types, and effectiveness of the partner's enhanced maintenance plan. Annual reports will provide survey results from the applicable calendar year, and the report at the end of the partner's commitment will summarize results and lessons learned over the entire course of the partner's commitment. This "end-of-commitment report" should include discussion of program lessons learned, emission reductions (i.e., from enhanced maintenance, valve repair, and/or valve replacement), maintenance / repair / replacement challenges, measurement frequency, enhanced corporate

⁴ Control device means any equipment used for oxidizing methane vapors. Such equipment includes, but is not limited to, enclosed combustion devices, flares, boilers, and process heaters.

⁵ If a partner feels it cannot measure without the acoustic device, please contact the Methane Challenge Program.

maintenance practices, costs, etc. Partners making this commitment should ensure they are tracking the necessary data each year so they are able to prepare this report at the end of the commitment.

Specific proposed data elements for Methane Challenge reporting on this emission source and BMP, including details on the end-of-commitment report, are detailed in Appendix B. Annual reports will be submitted on a facility-level basis.

Challenges

In Methane Challenge Partner National Fuel Gas's experience, valve repair/replacement can be cost-prohibitive.⁶ Cost-effective and improved isolation valve technologies, selection, maintenance, repair, and replacement options need to be evaluated. Other costs, such as station downtime (lost revenues) from valve malfunctions or repairs, and gas losses (and emissions) from station blowdown, may be incurred. In addition, there are cases where a new valve may show through-valve leaks when recommissioned.

⁶ <https://www.epa.gov/natural-gas-star-program/proposed-bmp-targeting-unit-isolation-blowdown-valves>

Appendix A. Commitment Progress Metric Calculation

To track a Partner's progress towards achieving its commitment to this emission source, EPA would calculate the 'progress metric' as follows:

- Metric Calculation

$$\frac{\textit{number of facilities with implemented annual inspection and maintenance program}}{\textit{total number of facilities}} * 100$$

- Metric Denominator - total number of facilities
- Metric Numerator - number of facilities to which the inspection and maintenance program has been rolled-out

Appendix B. Updates to Methane Challenge BMP Technical Document

Equipment Leaks/Fugitive Emissions – Compressor Isolation and Blowdown Valves

Applicable Segments: Transmission & Storage

Source Description: This commitment option addresses methane emissions at compressor stations from leakage through compressor blowdown and isolation valves.

Mitigation Options:

- Develop a compressor valve inspection, maintenance, and repair/replacement program
 - Implement an annual isolation and blowdown valve-focused leak survey at all compressor stations. Partners can measure the compressors as-found but are encouraged to work up to a biannual survey, timing the surveys so both the isolation and blowdown valve can be surveyed on each unit, each year
 - Develop an isolation and blowdown valve enhanced maintenance plan
 - Mitigate emissions from found leaks by any combination of the following:
 - Implementing activities identified in the enhanced maintenance plan that lead to emissions reductions, or
 - Repairing or replacing valves where practical (e.g., considering budgetary constraints, operating requirements and maintenance schedules). Repair/replacement should be targeted as soon as practical, but in no more than three years after identifying the leaking component, or
 - Routing isolation and blowdown valve leakage to a capture system for beneficial use to achieve at least a 95% reduction in methane emissions, or
 - Routing isolation and blowdown valve leakage to flare or control device⁷ to achieve at least a 95% reduction in methane emissions

Commitment Timeframe: Partners commit to implement the specified mitigation options for all sources included in their commitment by their designated commitment achievement date, not to exceed five (5) years from the commitment start date.

⁷ Control device means any equipment used for oxidizing methane vapors. Such equipment includes, but is not limited to, enclosed combustion devices, flares, boilers, and process heaters.

Facility-level Annual Reporting:

Emission Source	Quantification Method	Data Elements Collected via Facility-Level Reporting	GHGRP
Individual compressor	NA	Unique name or ID for the compressor	X
		Compressor type (Reciprocating or Centrifugal)	X
		Hours in operating-mode	X
		Hours in standby-pressurized-mode	X
		Hours in not-operating-depressurized-mode	X
		Which, if any, compressor sources are part of a manifolded group of compressor sources	X
		Indicate all of the following that apply to blowdown valve and isolation valve emissions from the compressor during the year:	
		Emissions are vented to the atmosphere	X
		Emissions are routed to vapor recovery	X
		Emissions are routed to flare	X
		Emissions are captured for fuel use or routed to a thermal oxidizer	X
		Emissions are part of a manifolded group of compressor sources	X
Compressor in not-operating-depressurized-mode all year (Y/N)	X		
Individual components on each compressor	NA	Unique name or ID for the compressor	X
		Unique name or ID for the individual vent to the atmosphere	X
		Type of component [Isolation valve; Blowdown valve] ⁸	X
		Did you repair or replace this component during the calendar year? [Repair; Replace; N/A]	
		If yes, date of repair or replacement	
		Did you implement an enhanced ⁹ maintenance program on the valve this year?	
	If yes, provide pertinent details on the maintenance activity(ies)		
	As found measurement or continuous measurement of individual compressor ^{10, 11, 12}	Mode in which the compressor was operating when measured (Operating; Standby-pressurized; Not-operating depressurized)	
		The measurement method used	X
		Measurement date	X
		Was this measurement taken before or after a mitigation action was implemented during the calendar year (if applicable) [Before; After; N/A]	

⁸ Wet seals on centrifugal compressors and rod packing on reciprocating compressors are outside of the scope of this commitment and will not be included in the reporting requirements for this commitment.

⁹ “Enhanced” maintenance refers to a data-driven approach that uses measurement to target certain valves for maintenance and will likely go beyond “recommended” maintenance.

¹⁰ Under this Methane Challenge commitment, partners should report measurements from all surveys conducted during the calendar year. The reporting form will be set up to accommodate this.

¹¹ 40 CFR 98.233(p)(1)(i)(A), (p)(2)(ii), (p)(6)(i), and (p)(11)

¹² 40 CFR 98.233(p)(1)(ii), (p)(3), (p)(7), and (p)(11)

Emission Source	Quantification Method	Data Elements Collected via Facility-Level Reporting	GHGRP
		Flow rate based on measurement type:	
		a. As found: Measured volumetric flow at standard conditions (scfh)	X
		b. Continuous: Measured volumetric flow at standard conditions (MMscf)	X
		Annual CH ₄ emissions (mt CH ₄)	X
	Site-specific EF ¹³	Reporter EF (scfh)	X
	Number of measured compressors (during the current year and 2 previous years) from which the reporter EF was developed	X	
	Annual CH ₄ emissions (mt CH ₄)	X	
Leak inspection and repair / replacement program details	NA	Number of surveys at this facility during the calendar year	
		How many compressors at this facility were surveyed this year?	
		How many vents indicated valve leakage this year?	
		How many leaking isolation valves were repaired or replaced this year?	
		How many leaking blowdown valves were repaired or replaced this year?	
		How many leaking isolation valves were routed to a capture system for beneficial use?	
		How many leaking blowdown valves were routed to a capture system for beneficial use?	
		How many leaking isolation valves were routed to flare or control device?	
		How many leaking blowdown valves were routed to flare or control device?	
		If valves were repaired or replaced, use this space to provide any pertinent details on the replacement/repaired valve's performance, installation, and design considerations	
		Voluntary action to reduce methane emissions during the reporting year	Difference in emissions before and after mitigation ¹⁴
Annual emissions reductions from voluntary action (mt CH ₄)			

¹³ The site-specific emissions factor approach is used when an as found measurement for the compressor is conducted in standby-pressurized-mode or in not-operating-depressurized-mode during the year (and an as found measurement is not conducted in operating mode). The site-specific emissions factor is developed from as found measurements of individual rod packing vent emissions from other compressors during the same year and the 2 previous years. 40 CFR 98.233(p)(1)(i)(A), (p)(2)(ii), (p)(6), and (p)(11).

¹⁴ This should be calculated on a compressor-by-compressor basis, subtracting emissions after mitigation from emissions before mitigation. Emissions after mitigation should be measured within 90 days of implementing the mitigation action.

End-of-Commitment Report:

This emission source will have a special “end-of-commitment” report in which partners will submit an analysis of their leak detection, maintenance, and repair/replacement program to inform future commitments. Partners making this commitment should ensure they are tracking these data each year, so they are able to prepare this report at the end of their commitment.

- Summary of “lessons learned”
- Analysis of leak counts and distribution
- Year-over-year leak changes, repair methods, and practices, including a discussion of the effects of implementing the enhanced maintenance plan
- Equipment / valve-specific recommendations
- Maintenance plan results and costs