



National Fuel[®]

Proposed BMP: Targeting Unit Isolation & Blowdown Valves

2019 Natural Gas Star &
Methane Challenge Workshop

November 5, 2019
Presented by Josh Ennis, PE

Safe Harbor For Forward Looking Statements



National Fuel®

This presentation may contain “forward-looking statements” as defined by the Private Securities Litigation Reform Act of 1995, including statements regarding future prospects, plans, objectives, goals, projections, estimates of oil and gas quantities, strategies, future events or performance and underlying assumptions, capital structure, anticipated capital expenditures, completion of construction projects, projections for pension and other post-retirement benefit obligations, impacts of the adoption of new accounting rules, and possible outcomes of litigation or regulatory proceedings, as well as statements that are identified by the use of the words “anticipates,” “estimates,” “expects,” “forecasts,” “intends,” “plans,” “predicts,” “projects,” “believes,” “seeks,” “will,” “may,” and similar expressions. Forward-looking statements involve risks and uncertainties which could cause actual results or outcomes to differ materially from those expressed in the forward-looking statements. The Company’s expectations, beliefs and projections are expressed in good faith and are believed by the Company to have a reasonable basis, but there can be no assurance that management’s expectations, beliefs or projections will result or be achieved or accomplished.

In addition to other factors, the following are important factors that could cause actual results to differ materially from those discussed in the forward-looking statements: changes in laws, regulations or judicial interpretations to which the Company is subject, including those involving derivatives, taxes, safety, employment, climate change, other environmental matters, real property, and exploration and production activities such as hydraulic fracturing; delays or changes in costs or plans with respect to Company projects or related projects of other companies, including difficulties or delays in obtaining necessary governmental approvals, permits or orders or in obtaining the cooperation of interconnecting facility operators; governmental/regulatory actions, initiatives and proceedings, including those involving rate cases (which address, among other things, target rates of return, rate design and retained natural gas), environmental/safety requirements, affiliate relationships, industry structure, and franchise renewal; financial and economic conditions, including the availability of credit, and occurrences affecting the Company’s ability to obtain financing on acceptable terms for working capital, capital expenditures and other investments, including any downgrades in the Company’s credit ratings and changes in interest rates and other capital market conditions; changes in the price of natural gas or oil; impairments under the SEC’s full cost ceiling test for natural gas and oil reserves; factors affecting the Company’s ability to successfully identify, drill for and produce economically viable natural gas and oil reserves, including among others geology, lease availability, title disputes, weather conditions, shortages, delays or unavailability of equipment and services required in drilling operations, insufficient gathering, processing and transportation capacity, the need to obtain governmental approvals and permits, and compliance with environmental laws and regulations; increasing health care costs and the resulting effect on health insurance premiums and on the obligation to provide other post-retirement benefits; changes in price differentials between similar quantities of natural gas or oil sold at different geographic locations, and the effect of such changes on commodity production, revenues and demand for pipeline transportation capacity to or from such locations; other changes in price differentials between similar quantities of natural gas or oil having different quality, heating value, hydrocarbon mix or delivery date; the cost and effects of legal and administrative claims against the Company or activist shareholder campaigns to effect changes at the Company; uncertainty of oil and gas reserve estimates; significant differences between the Company’s projected and actual production levels for natural gas or oil; changes in demographic patterns and weather conditions; changes in the availability, price or accounting treatment of derivative financial instruments; changes in laws, actuarial assumptions, the interest rate environment and the return on plan/trust assets related to the Company’s pension and other post-retirement benefits, which can affect future funding obligations and costs and plan liabilities; changes in economic conditions, including global, national or regional recessions, and their effect on the demand for, and customers’ ability to pay for, the Company’s products and services; the creditworthiness or performance of the Company’s key suppliers, customers and counterparties; the impact of information technology, cybersecurity or data security breaches; economic disruptions or uninsured losses resulting from major accidents, fires, severe weather, natural disasters, terrorist activities or acts of war; significant differences between the Company’s projected and actual capital expenditures and operating expenses; or increasing costs of insurance, changes in coverage and the ability to obtain insurance.

Forward-looking statements include estimates of oil and gas quantities. Proved oil and gas reserves are those quantities of oil and gas which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be economically producible under existing economic conditions, operating methods and government regulations. Other estimates of oil and gas quantities, including estimates of probable reserves, possible reserves, and resource potential, are by their nature more speculative than estimates of proved reserves. Accordingly, estimates other than proved reserves are subject to substantially greater risk of being actually realized. Investors are urged to consider closely the disclosure in our Form 10-K available at www.nationalfuelgas.com. You can also obtain this form on the SEC’s website at www.sec.gov.

For a discussion of the risks set forth above and other factors that could cause actual results to differ materially from results referred to in the forward-looking statements, see “Risk Factors” in the Company’s Form 10-K for the fiscal year ended September 30, 2018 and the Forms 10-Q for the quarter ended December 31, 2018, March 31, 2019, and June 30, 2019. The Company disclaims any obligation to update any forward-looking statements to reflect events or circumstances after the date thereof or to reflect the occurrence of unanticipated events.

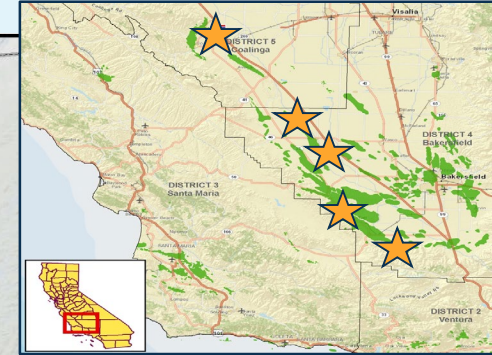
Corporate Overview

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NFG: A Diversified, Integrated Natural Gas Company

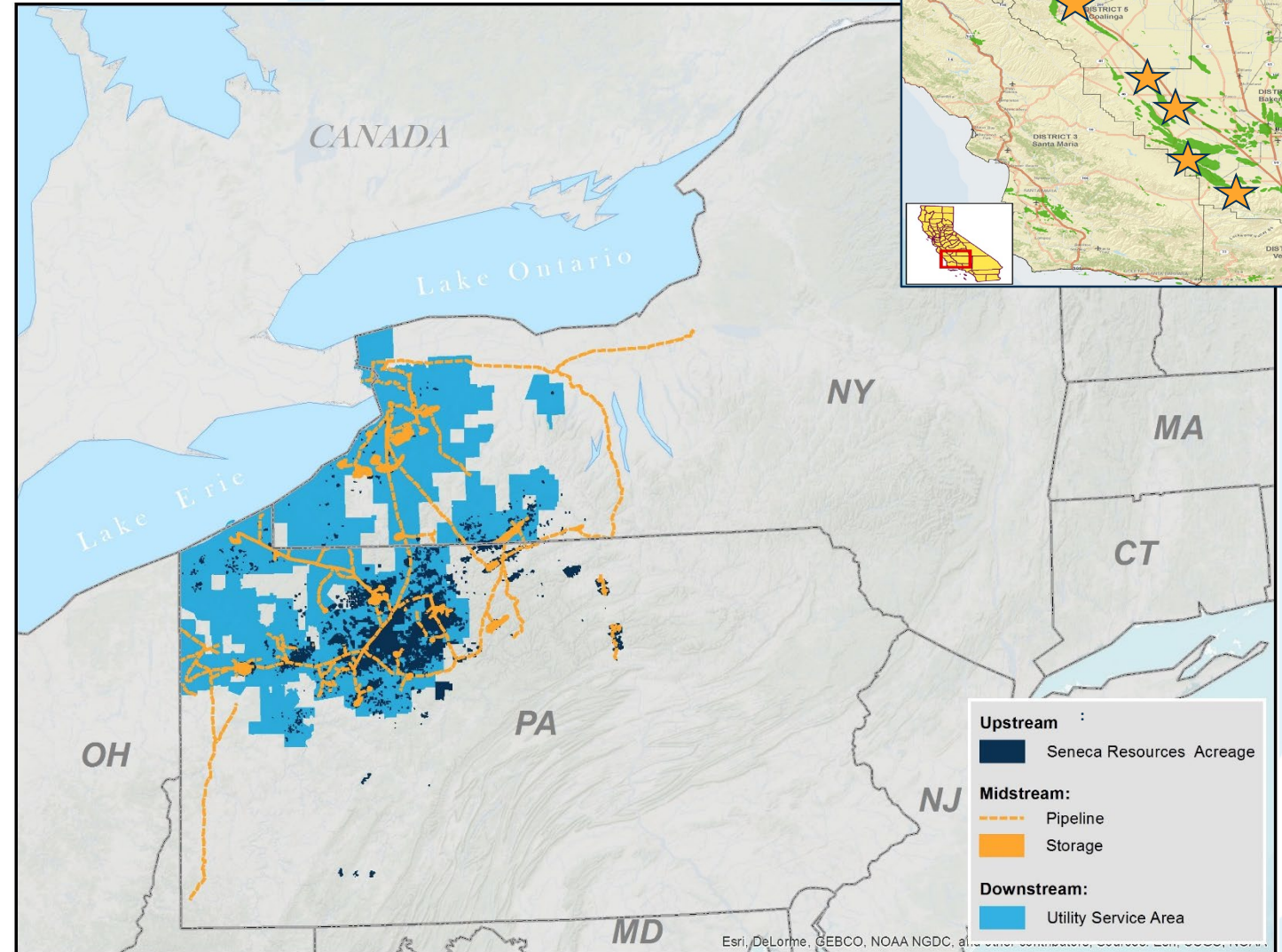


National Fuel®



More than 100 years of Operating History, with Uniquely Integrated Assets Across the Natural Gas Value Chain

- ✓ Buffalo, New York headquartered company, incorporated in 1902
- ✓ Geographic and operational integration across Western New York and Pennsylvania
- ✓ Serving local communities – providing natural gas service to over 750,000 customers in New York and Pennsylvania
- ✓ Over 2,000 employees in New York, Pennsylvania, Texas, and California.



Corporate Overview



National Fuel®

Upstream



Exploration & Production



Midstream



Gathering



National Fuel Gas Midstream

Pipeline & Storage



National Fuel
Supply Corporation



empire pipeline
A National Fuel Gas Company

Downstream



Utility



National Fuel
Distribution Corporation

Energy Marketing



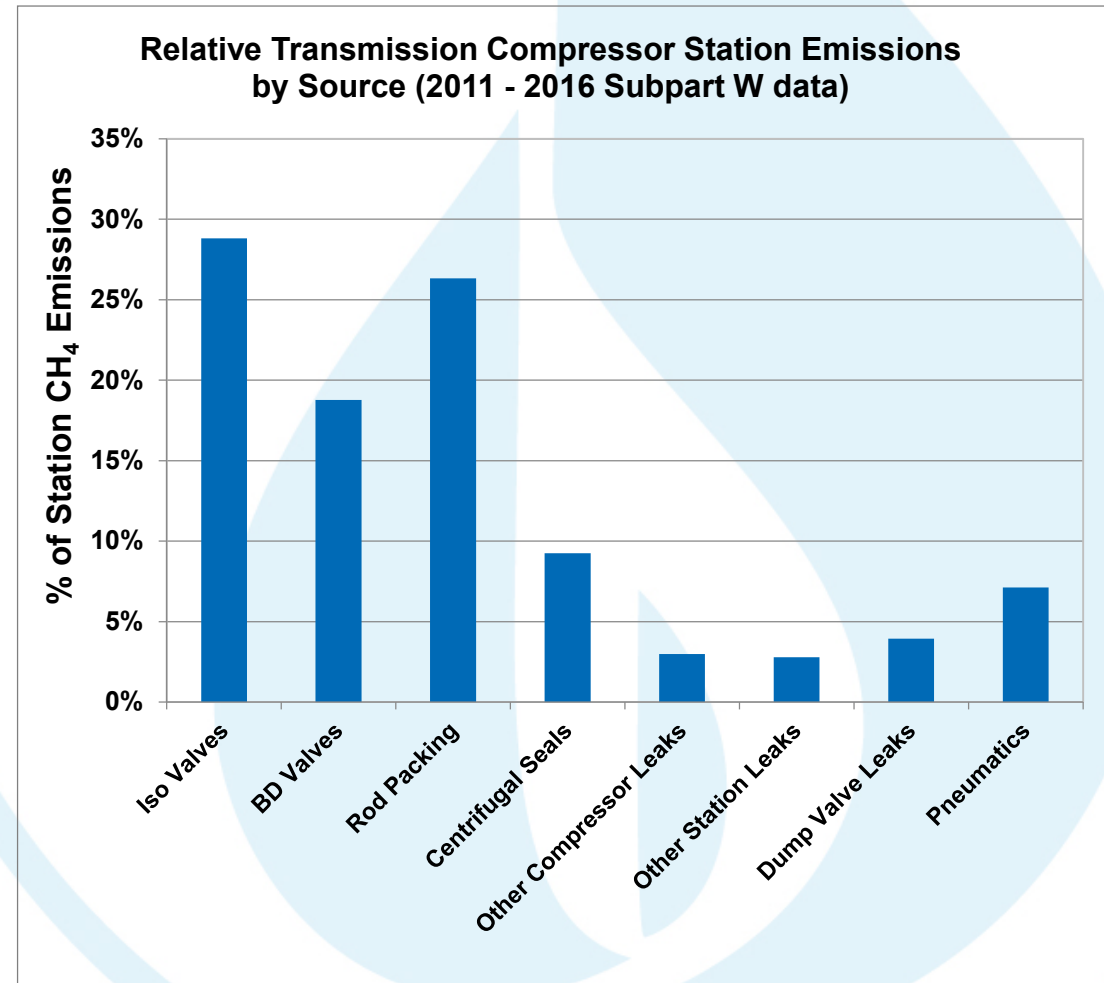
NATIONAL FUEL RESOURCES, INC.
DEREGULATED NATURAL GAS EXPERTISE
WWW.NFRINC.COM

Methane Challenge Commitments

Overview

Background Information

- April 2018 Pipeline Research Council International (PRCI) report analyzed Subpart W data from natural gas T&S facilities.
 - Over 10,000 compressor-related measurements were analyzed from 2011 – 2016 GHGRP Subpart W data *(14,000 Total - Acoustical Data Filtered Out)*
 - Data confirms isolation valves, and, to a lesser extent, blowdown valves are key emissions source when leakage occurs
- The EPA annual GHG inventory data indicates that about 90% of transmission and 80% of storage compressor stations GHG emissions are from compressor components (versus the balance of the facility).



Background Information - Continued

- Compressor components include:
 - Compressor isolation valves,
 - Blowdown valves, &
 - Seals
 - Reciprocating compressor rod packing and
 - Centrifugal compressor wet or dry seals
- Supply developed and submitted a proposed BMP under the Methane Challenge “Continuous Improvement Process”
 - Addresses through-valve leakage from compressor isolation and blowdown valves
 - Submitted: March 21, 2019 under Methane Challenge Continuous Improvement Program



Methane Challenge Commitments – Supply, Empire, & Midstream



Committed in 2018

Pneumatic Controllers

- Supply, Empire, & Midstream
- Prioritize compressor stations
- Conduct inventories and replace high bleed pneumatic devices when practical

Committed in 2018

Rod Packing

- Supply & Midstream
- Commit to maintenance schedule of 26,000 operating hours
- Document results annually as they occur

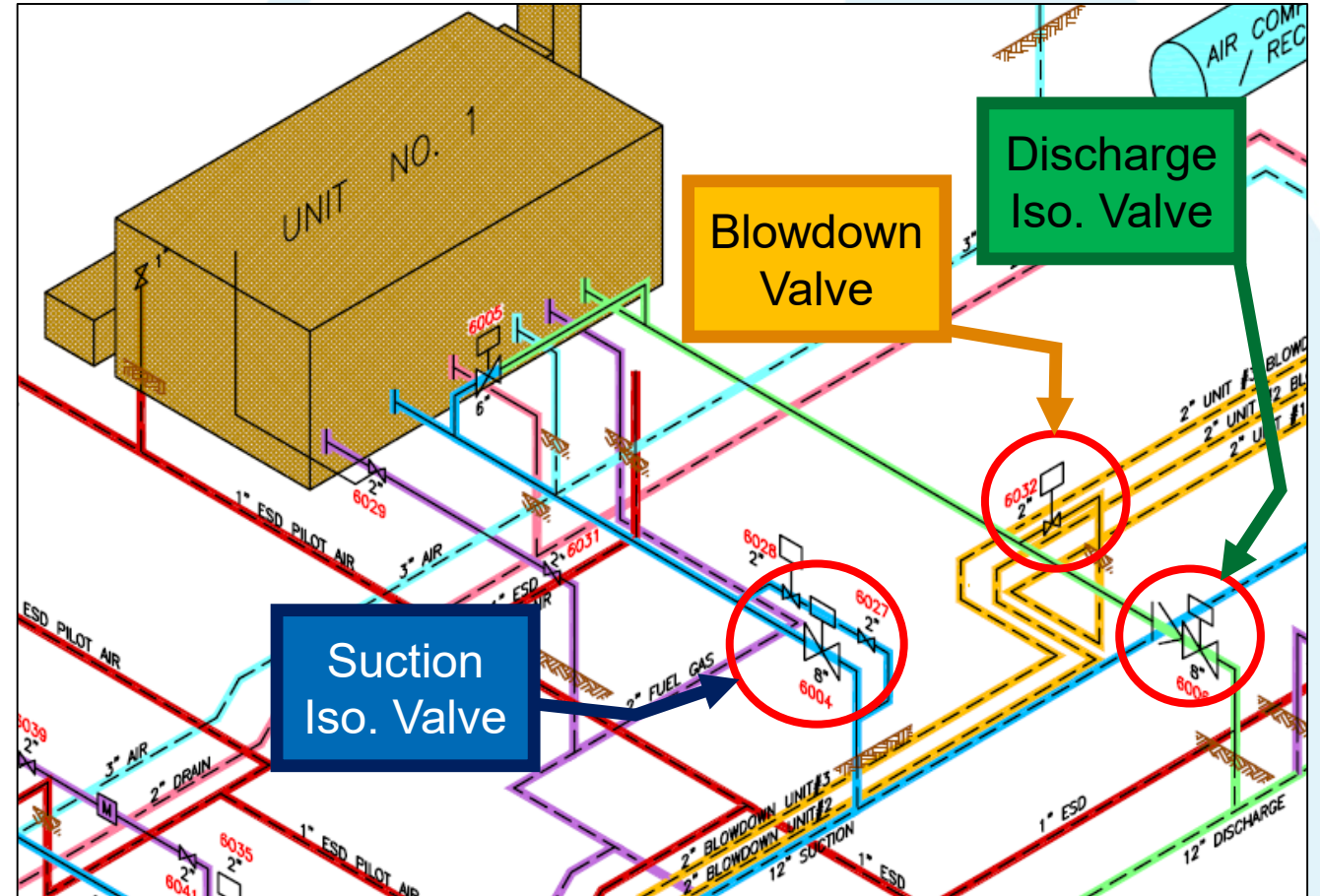
Approval Pending

Equipment Leaks/Fugitives*

- Supply
- Commit to measuring leaks from Isolation & Blowdown Valves
- Develop a valve maintenance, repair, and replacement program

Schematics – Isolation and Blowdown Valves

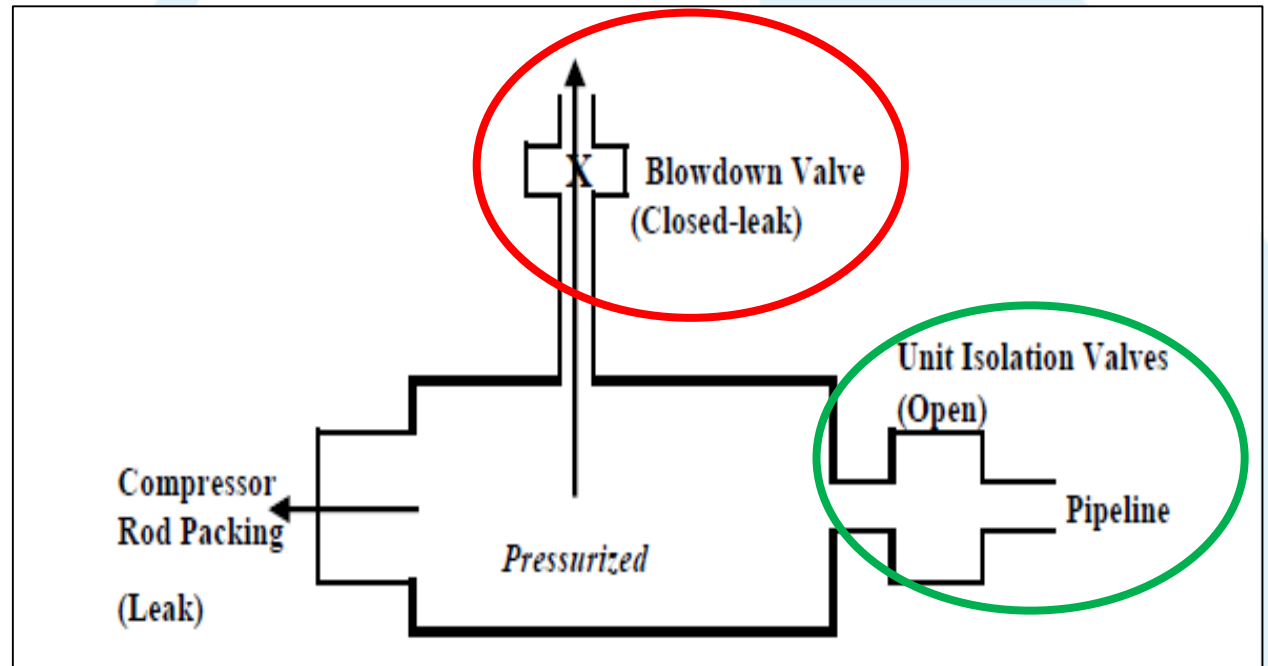
- Facility Schematic
 - Suction & Discharge Isolation valves
 - Blowdown valves
- Two Primary Modes of Operation
 - Operating Pressurized Mode
 - Not Operating Depressurized Mode



Example Facility Schematic

Mode of Operation – Operating Pressurized Mode

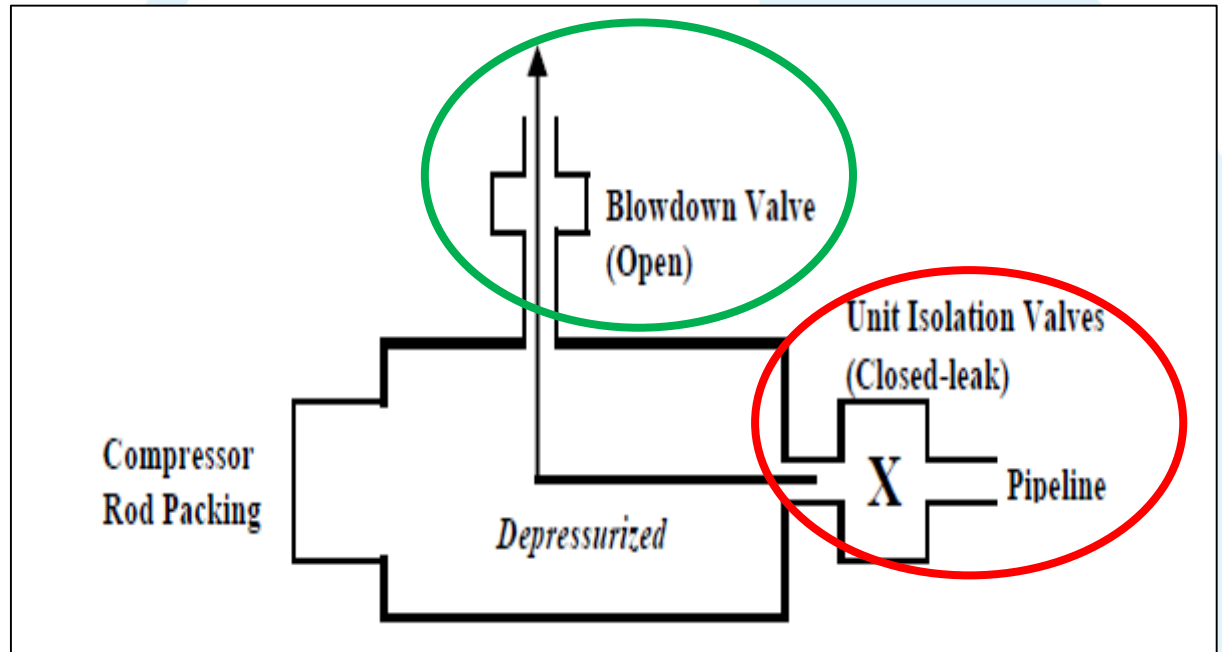
- Isolation valves are **open** and the blowdown valve(s) is **closed** against both high-pressure suction and discharge compressor gas
- Natural gas may leak to atmosphere via blowdown valve(s)
- Blowdown valve leakage is typically routed to the atmosphere via the blowdown valve vent line
- Vent lines are considered “Elevated vent sources,” and visualized using optical gas imaging
- 1” Ports on vent lines allow for leak measurement and quantification



Potential Leak during Operating Pressurized Mode

Mode of Operation – Not Operating Depressurized

- Isolation valves are **closed** against both high-pressure suction and discharge pipeline gas and the blowdown valve(s) is **open**
- Natural gas may leak to atmosphere via isolation valves
- Isolation valve leakage is typically routed to the atmosphere via the open blowdown valve vent line
- Vent lines are considered “Elevated vent sources,” and visualized using optical gas imaging
- 1” Ports on vent lines allow for leak measurement and quantification



Potential Leak during Not Operating Depressurized Mode

Valve Repair or Replacement- Challenges



➤ Challenges:

- Significant Cost - Example: 8” plug valve replacement \approx \$50k
- Replacement valve purchasing - long lead times \approx 6 months+
- Station downtime from valve repairs or replacement
- Need improved isolation valve technologies – 2019 PRCI Study
- Gas loss (and emissions) from station blowdowns
- New valves may have through-valve leaks when (re)commissioned

Proposed BMP Addresses

➤ Proposed Valve BMP Addresses:

- 1) Methods to identify and measure through-valve leakage
- 2) Enhanced maintenance practices for isolation valves
- 3) Compressor station design considerations to facilitate improved access to isolation valves for maintenance, repair, and replacement
- 4) Isolation valves that are less prone to through-valve leakage
- 5) Leaking isolation valve repair or replacement decision guidelines

Proposed BMP – Key Program Elements

- **Annual valve survey across all T&S compressor stations within 5 years**
 - Prioritize Stations - based on GHGRP data, age, utilization, etc.
 - Additional 20% of facilities incorporated each year
 - After end of 5 year period all stations have annual survey completed each year
- **Build a more detailed valve inventory for all T&S compressor stations**
 - Type, Manufacturer, Size, Model, etc.
- **Develop & Implement enhanced maintenance program across all T&S compressor stations within 5 years**
 - Specific for Isolation & Blowdown Valves
 - Manufacturer's recommendations
 - Specialized Training
 - Documentation

Proposed BMP – Key Program Elements



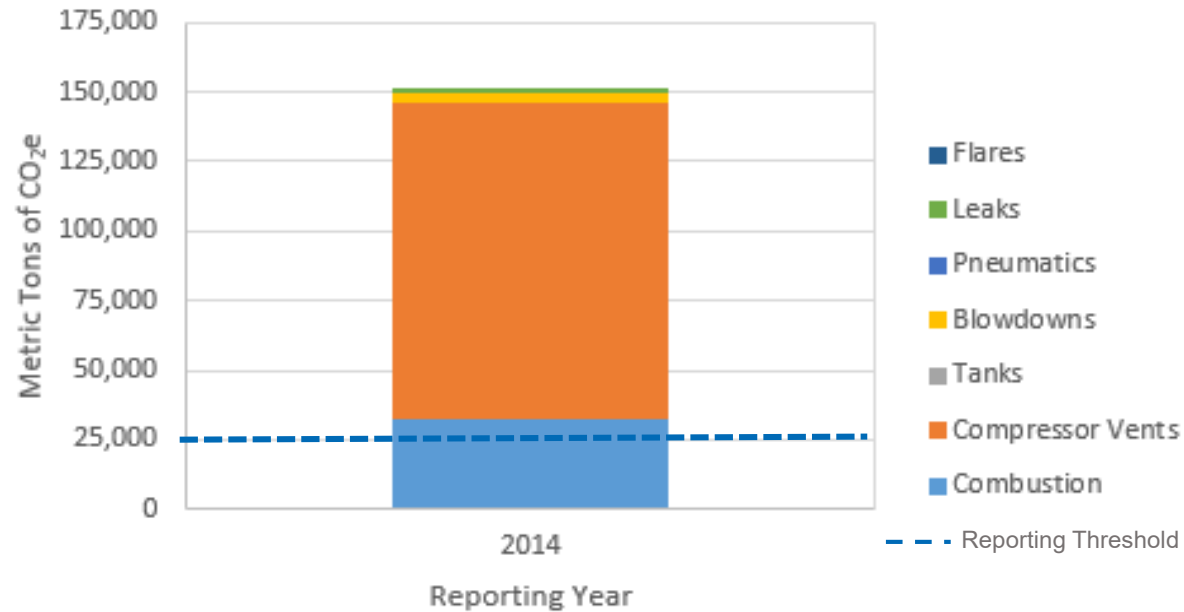
- **Leak rate measurement will utilize Methodologies from Subpart W of the GHGRP**
 - Measurement data will be utilized for program applicability – maintenance, repair or replacement
 - Emission reductions will be based on leak rate measurements
- **Valve repairs and/or replacement will be completed when/where practical, and within 3 years**
 - Operational issues such as the need for system/facility blowdown, scheduled outages for maintenance, parts, availability of repair personnel, etc. will be considered when determining the valve repair or replacement schedule
- **Annual facility-level reporting will include:**
 - Program results, status, and future plans - survey, maintenance, repair, and replacement data
 - 5th year will include a discussion of “lessons learned” regarding leak counts, year-to-year leak changes, repair methods and practices, equipment / valve-specific recommendations, maintenance plan results and costs



**NFG Case Study:
Iso Valve Enhanced Maintenance & Replacement**

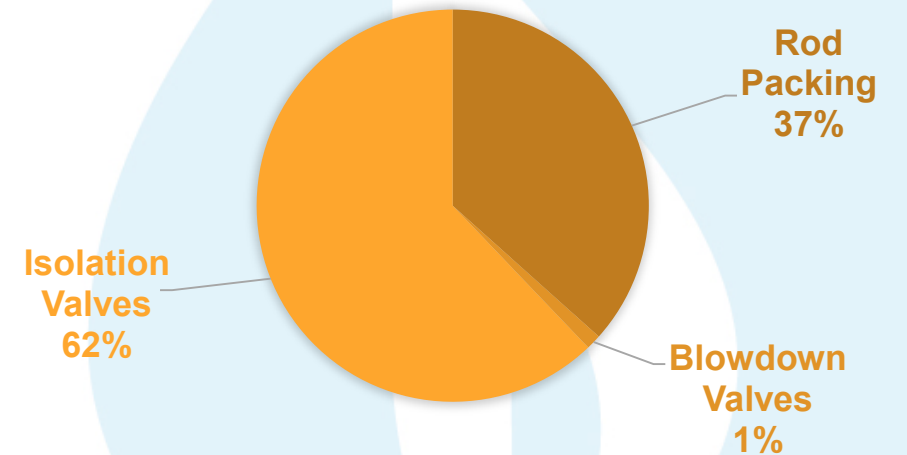
NFG Case Study: Pre 2015 Compressor Components

Summary of Measured and Estimated GHG Emissions from Case Study



Compressor Component Venting \approx 75% of facility CO₂e emissions

2014 COMPRESSOR VENT EMISSIONS



NFG Case Study: Enhanced Maintenance Program

- Enhanced program started 2015
- Expansion of standard valve maintenance
 - Prepopulated library of valve numbers, location description, size, type, sealant
 - Field operations indicates date, employee number, and % injected (i.e., 15%, 25%, 50%, and 100%)

Ball Valves					Maximum Injection Pressure	Plug Valves				
Valve Size	Volumes in oz's					Valve Size	Volumes in oz's			
	100%	50%	25%	15%			100%	50%	25%	15%
1					Forged Steel & High Pressure Plug Valves 9000 psi max	1	1 oz	.5 oz	.25 oz	.15 oz
2	4 oz	2 oz	1 oz	.5 oz		2	2 oz	1 oz	.5 oz	.3 oz
4	8 oz	4 oz	2 oz	1.2 oz		4	4 oz	2 oz	1 oz	.5 oz
6	12 oz	6 oz	3 oz	1.8 oz		6	9 oz	4.5 oz	2 oz	1.3 oz
8	16 oz	8 oz	4 oz	2.4 oz	High Pressure Ball Valves 4500 psi max	8	12 oz	6 oz	3 oz	1.8 oz
10	20 oz	10 oz	5 oz	3 oz		10	15 oz	7.5	3.7 oz	2.25 oz
12	24 oz	12 oz	6 oz	3.6 oz		12	18 oz	9 oz	4.5 oz	2.7 oz
16	32 oz	16 oz	8 oz	4.8 oz		16	40 oz	20 oz	10 oz	6 oz
20	40 oz	20 oz	10 oz	6 oz	Low Pressure and Cast Iron Plug Valves 2500 psi max	20	72 oz	36 oz	18 oz	10.8 oz
24	48 oz	24 oz	12 oz	7.2 oz		24	88 oz	44 oz	22 oz	13.2 oz

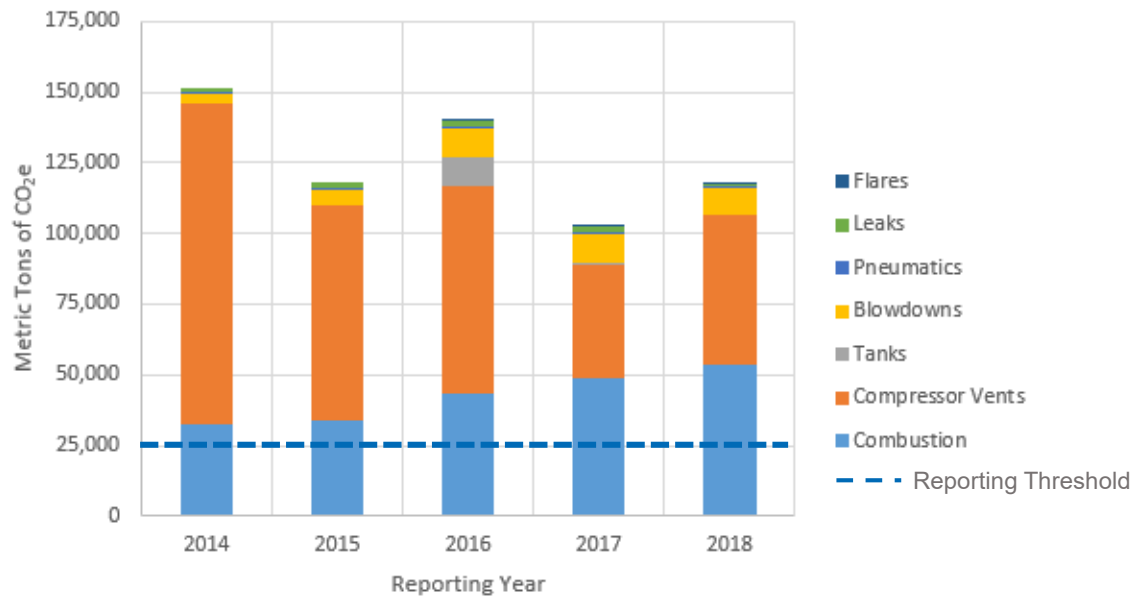
Hydraulic Hand Pump 45 - 50 strokes per ounce
Activ-8 Injection Pump - One stroke of the Jack loads 2 ounces

Reference guide at the bottom of every field form

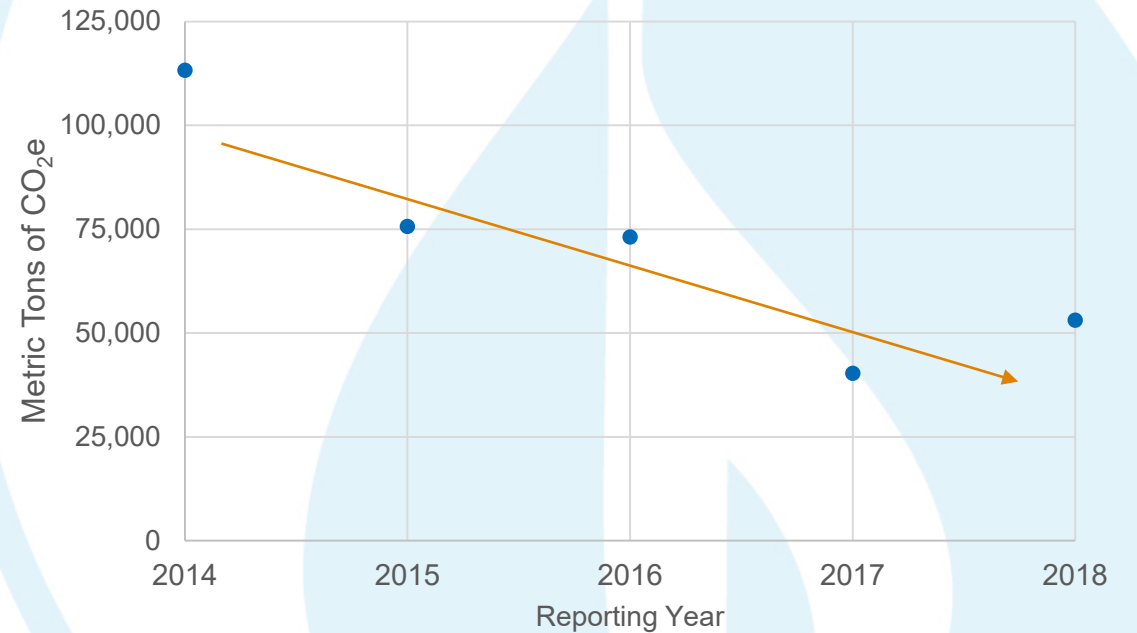
Unit 1A - Valve Sealant/Lubricant Injected (Activity Number 530452)							
Date	Employee number	Valve Number	Location	Size	Type	Sealant Used	Percent Injected
		5919	Suction Valve 16" Suction Header	10	<input type="checkbox"/> Ball <input checked="" type="checkbox"/> Plug	<input type="checkbox"/> Equalube <input checked="" type="checkbox"/> 1033	<input type="checkbox"/> 15% <input type="checkbox"/> 25% <input type="checkbox"/> 50% <input type="checkbox"/> 100%

NFG Case Study: 2015 + Maintenance & Replacement

Summary of Measured and Estimated GHG Emissions from Case Study



Compressor Venting Emissions (Metric Tons of CO₂e)

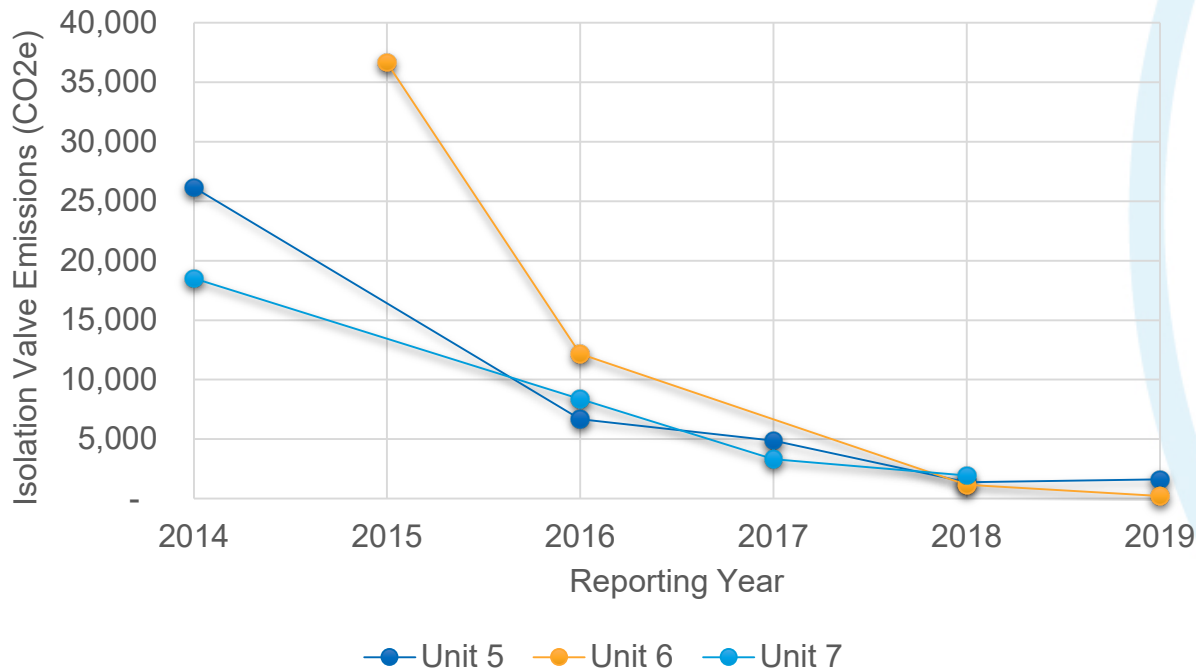


Enhanced Maintenance Program commenced in 2015 led to reductions

2014 – 2018 Total Compressor Venting ≈ 54% decrease

NFG Case Study: 2015 + Valve Replacement

Case Study: Isolation Valve Emissions (2014 - 2019)



*2019 Values are Projections Only for Remainder of Year

- Replacement of the Suction Isolation Valves on Units 5, 6, & 7 occurred in late 2017 and resulted in further reductions
- In total - 9 Suction Isolation Valves were replaced

Reductions	Unit 5	Unit 6	Unit 7
'14/'15 – '16	74%	67%	55%
'14/'15 – '17	81%	N/A*	82%
'14/'15 – '18	95%	97%	90%
'14/'15 – '19	95%	99%	N/A*

*N/A = no measurement taken

Closing

- **NFG moving forward ...**
 - Completing detailed valve inventory
 - Developing enhanced valve maintenance program
 - Implementing enhanced valve maintenance program at additional 20% of facilities incorporated each year
 - Replacement of isolation valves at additional facility Fall 2019
- **Working with EPA for finalization of proposed BMP**
- **Draft BMP for public review and comment forthcoming**

Thank you!

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