



# Test and Repair Pressure Safety Valves



## Technology/Practice Overview

### Description

If a pressure surge in a compressor, pipeline, or pressure vessel exceeds the maximum operating pressure for the system, pressure safety valves (PSVs, or pressure relief valves, PRVs) will open and vent excess gas to the atmosphere. Over time, the valve seats wear or become fouled with debris, and will leak gas. Small leaks will grow larger as the leak point erodes or is subject to corrosion.

Gas STAR Partners find that pipeline valves, connections, compressor valves and open-ended lines are major sources

of fugitive methane emissions. A study of fugitive emissions in four gas processing plants found that only 0.4 percent of leaking equipment components were pressure relief valves, yet they contributed 3.5 percent of the total fugitive emissions.

EPA’s Natural Gas Star Partners report a practice of regularly screening PSVs for leakage, and repairing them as needed. A proactive testing and repair program can dramatically reduce fugitive methane losses. Some partners include screening of PSVs in a directed inspection and maintenance (DI&M) program.

- Compressors/Engines
- Dehydrators
- Directed Inspection & Maintenance
- Pipelines
- Pneumatics/Controls
- Tanks
- Valves
- Wells
- Other

### Applicable Sector(s)

- Production
- Processing
- Transmission
- Distribution

### Other Related Documents:

Replace Burst Plates with Secondary Relief Valves, PRO No. 605

Conduct DI&M at Remote Facilities, PRO No. 901

## Economic and Environmental Benefits

### Methane Savings

Estimated annual methane emission reductions 124 Mcf – 2,500 Mcf per leaking PSV

### Economic Evaluation

Estimated Gas Price	Annual Methane Savings	Value of Annual Whole Gas Savings*	Estimated Implementation Cost	Incremental Operating Cost	Payback (months)
\$7.00/Mcf	124 – 2500 Mcf	\$923 – \$18,000	\$250	Data not available	3 months – immediate
\$5.00/Mcf	124 – 2500 Mcf	\$660 – \$13,300	\$250	Data not available	5 months – immediate
\$3.00/Mcf	124 – 2500 Mcf	\$395 – \$7800	\$250	Data not available	8 months – 1 month

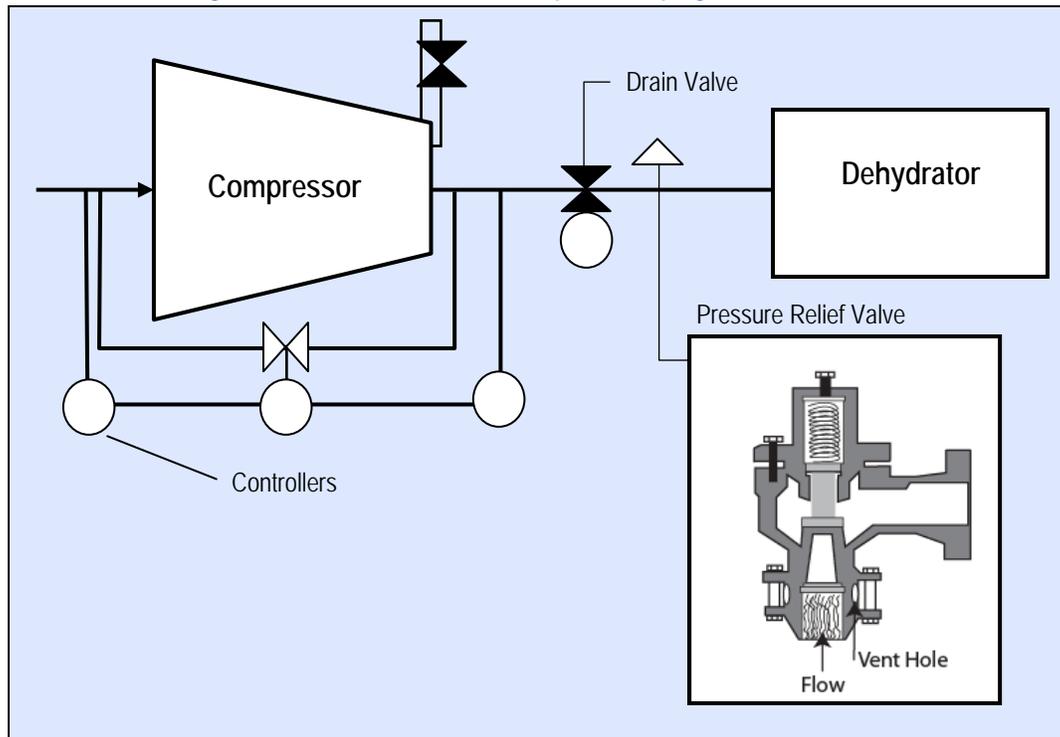
\* Whole gas savings are calculated using a conversion factor of 94% methane in pipeline quality natural gas.

### Additional Benefits:

- Gas savings and reducing methane emissions
- Improved operational readiness and equipment safety

## Test and Repair Pressure Safety Valves (Cont')

Schematic Showing a Pressure Relief Valve on Compressor Piping



### Methane Emissions

The volume of fugitive methane emissions from PSVs will depend on the age of the equipment, operating pressure and equipment maintenance. An industry study<sup>1</sup> estimated average annual methane emissions from leaking PSVs in gas processing plants to be 844 Mcf per valve; Gas STAR partners report a wide range of methane emissions depending on their operations.

One partner screened approximately 100 pressure relief valves and found 25 percent to be leaking. Twenty-five valves were repaired yielding total methane savings of 500 Mcf, approximately 20 Mcf per PSV. A distribution partner repaired 4 pressure

safety valves on compressor discharge lines for savings of 124 Mcf per valve. Another distribution partner repaired two compressor discharge relief valves, saving 467 Mcf per valve. Two gate station pressure safety valves with a history of leaking were replaced, producing total savings of 5000 Mcf.

In high pressure applications, leaking PSVs can be a major source of methane emissions. One partner reported that a leaking one-inch pressure relief valve emitted almost 36,744 Mcf/year. Five man-hours of labor and \$125 of material eliminated the leak, producing annualized savings of more than \$110,000 at \$3.00/Mcf.

### Operating Requirements

While PSVs are in service, screening to locate leaking valves can be accomplished with an organic or toxic vapor analyzer (OVA,TVA), acoustic and ultrasound leak detection, or optical imaging using an infrared camera. If leaks are detected, options available to quantify the leak volume include a high volume sampler, bagging techniques or a rotameter. Additionally, acoustic and ultrasonic leak detectors often include an estimation algorithm which enables calculation of emission volumes based on the device's reading. Once quantified, leaks are fixed, or tagged and prioritized for future repair.

### Applicability

Partners find that infrared imaging is an efficient approach to identify leaking valves, providing a real time visual image of the leaks. Optical techniques also offer qualitative assessment of leak size for inaccessible areas by simply viewing them. Partners report that the high-volume sampler is often the most effective tool for quantifying leaks and identifying cost-effective repairs. This approach of rapidly screening, evaluating and repairing leaks can be applied to pressure safety valves on all types of equipment in all natural gas industry sectors.

### Methane Content of Natural Gas

The average methane content of natural gas varies by natural gas industry sector. The Natural Gas STAR Program assumes the following methane content of natural gas when estimating methane savings for Partner Reported Opportunities.

Production	79 %
Processing	87 %
Transmission and Distribution	94 %

## Test and Repair Pressure Safety Valves (Cont')

### Economic Analysis

#### *Basis for Costs and Savings*

Typical total repair costs (labor and materials) for leaking PSVs are expected to range from approximately \$75 to \$250 per valve in current dollars.<sup>2</sup> The cost of complicated repairs that require significant labor will likely be higher. This analysis assumes a range of Partner-reported annual emissions savings from 124 Mcf to 2500 Mcf, and the high-end estimated repair cost of

\$250 per valve. At gas prices ranging from \$3.00 to \$7.00, the PSV repairs pay back almost immediately for the large leak example (2500 Mcf), and within 3 to 8 months for the small leak example (124 Mcf).

#### *Discussion*

Testing and repair of leaking pressure safety valves provides cost-effective methane savings across a range of leak rates, repair costs, and likely gas prices. Depending on the age, operating pressure, and equipment components of a facility, regular screening and repair of leaking PSVs can be part of the facility's directed inspection and maintenance (DI&M) program. Emissions from a leaking valve can be substantial for PSVs on high pressure equipment. If no facility DI&M program is in place, a monitoring and repair effort targeting only PSVs would be cost-effective and could reduce methane losses significantly.

#### Pressure Relief Valves on Separators at a Production Site



Source: Advanced Resources International

1. Clearstone Engineering, 2002, *Identification and Evaluation of Opportunities to Reduce Methane Losses at Four Gas Processing Plants*.
2. Ananthakrishna, S. and C. Henderson, 2002, Cost-effective emissions reductions through leak detection and repair, *Hydrocarbon Processing*, May 2002.

EPA provides the suggested methane emissions estimating methods contained in this document as a tool to develop basic methane emissions estimates only. As regulatory reporting demands a higher-level of accuracy, the methane emission estimating methods and terminology contained in this document may not conform to the Greenhouse Gas Reporting Rule, 40 CFR Part 98, Subpart W methods or those in other EPA regulations.