Reducing Emissions Through Retrofitting of High Bleed Devices

Presented By: Greg Giernoth
Every year, a single unit of pneumatic control valve instrumentation typically releases 500,000 scf of natural gas emissions into the atmosphere.
This is equivalent to 28 tons of CO$_2$ or the annual greenhouse gas emissions from 5 passenger vehicles.

Source: EPA Greenhouse Gas Equivalencies Calculator
# Pneumatic Devices per Sector

<table>
<thead>
<tr>
<th></th>
<th>Number of Devices in Natural Gas Systems</th>
<th>Number of Devices in Petroleum Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production and Gathering</td>
<td>478,000</td>
<td>399,000</td>
</tr>
<tr>
<td>Transmission and Storage</td>
<td>85,000</td>
<td>-</td>
</tr>
</tbody>
</table>

Pneumatic Device Emissions

Methane Emissions (Bcf) from Pneumatic Devices Per Year

- Production: 31 Bcf
- Processing: 16 Bcf
- Transmission: 14 Bcf

One of The Largest Sources of Vented Methane Emissions in the Natural Gas Industry
Where Pneumatic Devices are Used

Various Segments of the Gas Industry Have Different Equipment and Different Standard for Using Pneumatic Devices

Pneumatic Devices Linked to Control Valves Are the Largest Source of Pneumatic Emissions in the Natural Gas Industry*

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<table>
<thead>
<tr>
<th></th>
<th>Production</th>
<th>Processing</th>
<th>Transmission</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Valves</td>
<td>Yes</td>
<td>Very Few</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Operated by Gas?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation Valves</td>
<td>No</td>
<td>Some</td>
<td>Yes</td>
<td>Some</td>
</tr>
<tr>
<td>Operated by Gas?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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*Source: EPA Methane Emission for the Natural Gas Industry Volume 12: Pneumatic Devices
Average Bleed Rates for NG Sector

Canadian Petroleum Association (CPA) Study*

| Measured Emissions Rates for Continuous Bleed Devices |
|---------------------------------|---------------------------------|-----------------|-----------------|
|                                 | Production Onshore | Production Offshore | Total Production | Transmission |
| Number of Measurements          | 9                 | 9                | 18              | 23            |
| Minimum, (scfd/device)          | 380               | 108              | 108             | 152           |
| Maximum, (scfd/device)          | 2,334             | 962              | 2,334           | 4,215         |
| Average, (scfd/device)         | 1,189 ± 39%       | 556 ± 33%        | 872 ± 30%       | 1,363 ± 29%   |

Minimum Production: 39.42 mscf/year per device
Minimum Transmission: 55.48 mscf/year per device

*A Detailed Inventory of CH₄ and VOC Emissions From Upstream Oil and Gas Operation in Alberta* – Canadian Petroleum Association
Identifying Retrofit Opportunities
Types of Devices

- **Continuous** bleed devices are used to modulate flow or pressure and will generally vent gas a steady state.

- **Actuating or Intermittent** bleed devices perform snap-acting or control and release gas only when they stroke a valve open or close or as they throttle gas flow.

- **Self-Contained** devices release gas into the downstream pipeline, not the atmosphere.
Why Retrofit?

Reduce or Eliminate emissions from high bleed instrumentation
Minimize control instrumentation maintenance
Simplify Control Logic
Maintain System consistency
Retrofit will pay for itself
Increase durability and ruggedness
The Replacements

Lower Bleed Pressure Controllers

ZERO Bleed Pilot Controllers
Typical Control Valve Configuration
ZERO Steady State Bleed Solution

ZERO Bleed Pilot
ZERO Steady State Emissions

Spring & Diaphragm Actuator

Control Valve

P₁

P₂

Sensing
Pneumatic Signal
Supply Gas
Positioner Output
Bleed To Pressure System

Completely Eliminates Emissions

ZERO Bleed Pilot
ZERO Emissions

Gas Displaced Back into the Pipeline

\[ P_2 \leq 300 \text{ psi} \quad (\sim 20 \text{ bar}) \]

\[ \Delta P \geq 80 \text{ psi} \quad (5.5 \text{ bar}) \]

High Pressure Actuator

Control Valve

\[ P_1 \]
Retrofit Examples
Newer Trial Site: PEMEX
Venta de Carpio Gas Station

Application: Sales & Metering Regulation Station
- Existing Equipment: Fisher 4150
- Retrofit: VRP-SB-CH
Bleed to Pressure Example

Before

Company: National Grid UK
Problem: Frequent Gas Call Outs and Station in Enclosed Building

Previous Equipment:
- Four (4) Moore 750 Pneumatic Valve Positioners
- Eight (8) Bristol 624 – II Pneumatic Pressure Controllers
- Four (4) Actuators on Axial Style Valves

Bristol 624 Controllers Constantly Venting Gas

Axial Style Valve Equipped with Moore 750 pneumatic positioner, two inch (50mm) diameter piping used to vent gas to atmosphere
Bleed to Pressure Example

After

Company: National Grid UK
Problem: Frequent Gas Call Outs and Station in Enclosed Building

Becker Solution:
- Replaced Moore 750 Positioners with Becker HPP and Bristol 624 –II Controllers with Becker VRP
- Implemented Becker Bleed to Pressure System with Becker LPDA actuator
- Eliminated natural gas emissions from station with Becker ZERO BLEED™ instrumentation

Becker VRP ZERO BLEED™ feature eliminated Steady State Emissions

Becker High Pressure Positioner (HPP) and LPDA actuator allows gas to be discharged into a downstream Bleed to Pressure system—eliminating ALL emissions
Bleed to Pressure

ROI

<table>
<thead>
<tr>
<th>Station Control Valve Emissions - Before</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Instrumentation</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Bristol 624 – II Controller</td>
</tr>
<tr>
<td>Moore 750 Positioner</td>
</tr>
<tr>
<td>Total Gas Lost</td>
</tr>
</tbody>
</table>

*Assumed European NG price of $7/MCF

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<thead>
<tr>
<th>Emissions Reduced Summary - After</th>
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</thead>
<tbody>
<tr>
<td>Total Annual Emissions Reduced</td>
</tr>
<tr>
<td>Equivalent to the Annual CO₂ Emissions From:</td>
</tr>
<tr>
<td>Equivalent to the Carbon Sequestered Annually by:</td>
</tr>
<tr>
<td>Total Annual Savings</td>
</tr>
<tr>
<td>Approximate Payback Period</td>
</tr>
</tbody>
</table>

*Equivalent to 142.2 Metric Tons of CO₂
Partial System Upgrade

Nicor Gas - One of the nation’s largest distribution companies

Largest natural gas distributor in Illinois

Network of more than 29,000 miles of pipeline
Partial System Upgrade cont.

Recognized benefits from ZERO Bleed pressure control system

Implemented system-wide retrofit

• Replaced 25 “high-bleed” pneumatic controls
• 15 locations
• Mechanical controls used for all new installations
Partial System Upgrade cont.

Cumulative Total Permanent Bleed Gas Savings (SCF/Year): **81,698,570**

*Source: EPA Methane Emission for the Natural Gas Industry Volume 12: Pneumatic Devices*
Partial System Upgrade cont.

Total emissions reduced from this project equivalent to:

- 89,200 passenger cars not driven for a year
- 2,540 railcars of coal not burned
- 1,132,700 barrels of oil not used
- 12,489,100 tree seedlings carbon sequestered
- 110,700 acres pine acres carbon sequestered

Eliminated emissions equivalent to the gas use of over 1,850 homes

*Source: EPA Methane Emission for the Natural Gas Industry Volume 12: Pneumatic Devices*
Tools For Retrofitting
The EPA Website
More detail is available on these practices:
epa.gov/gasstar/tools/recommended.html
GE Valve Emissions Calculator

Provides calculations based on predominate regional currency & market price

Registration *may be skipped*

*If registration skipped tool will default to USD($) market pricing*

www.ge-valve-emissions-calc.com
Select from a drop down menu of common manufacturer models.
*Selection will default to manufacturer consumption rate.

If model is unknown you be elect to use “Average Model” which defaults to an assigned value.

Hover over any of the “Information Icons” for more information on the field.

Easily override bleed rate.

As an option, you may take age into account. *The calculator assumes 1% increase in bleed rate a year.
Your Emissions Reduction with a Becker Valve Regulator Pilot (VRP)

Summary Of Input:

1. Average Model
2. Average Model

By replacing this instrumentation with a Becker Valve Regulator Pilots (VRP):

You could reduce your emissions output by approximately 500,196 standard cubic feet of methane a year.

Which is equivalent to approximately 28 tons of CO₂ a year.

Providing a total annual lost gas savings of approximately ¥45,693.00*.

*at a rate of ¥ 91.35 per thousand cubic feet (McF) of natural gas

This emissions reduction would be roughly equivalent to:

Eliminating the annual greenhouse gas emissions from 5 passenger vehicles.

Or

The carbon sequestered annually by 5 acres of pine forests.

PLEASE NOTE: This calculation is provided as a convenience; it is not intended and should not be relied on as a representation or warranty. Actual results may vary depending on the circumstances.
Mobile Device Compatible
Calculate on the go!