Natural Gas STAR International: An Overview of Pneumatic Valve Emission Reduction Best Practices

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ICF International
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Agenda

- 2009 U.S. Production Sector Methane Emissions
- What is the Problem?
- Methane Emissions from Pneumatic Devices
- How Gas Pneumatic Devices Work
- Methane Recovery
- Industry Experience
- Lessons Learned
- Contacts and Further Information
2009 U.S. Production Sector Methane Emissions (11,243 MMcm)

- **Pneumatic Devices**: 1,897 MMcm
- **Dehydrators and Pumps**: 538 MMcm
- **Compressor Fugitives, Venting, and Engine Exhaust**: 510 MMcm
- **Storage Tank Venting**: 397 MMcm
- **Meters and Pipeline Leaks**: 340 MMcm
- **Offshore Operations**: 1,048 MMcm
- **Well Venting and Flaring**: 6,145 MMcm
- **Other Sources**: 368 MMcm

MMcm = million cubic meters

What is the Problem?

- Natural gas-powered pneumatic devices are used throughout the U.S. oil and natural gas industry
- Pneumatic devices are collectively a major source of methane emissions in the U.S. oil and natural gas industry

<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>
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</table>

Pneumatic Devices: Methane Emissions

- As part of normal operations, pneumatic devices release natural gas to the atmosphere
- High-bleed devices are defined as those that bleed in excess of 4 m³ per day
  - Aggregates to more than 1,416 m³/year
  - Typical high-bleed pneumatic devices bleed an average of 3,965 m³/year
- Actual bleed rate is largely dependent on device’s design and maintenance
Location of Pneumatic Devices at Production Sites

SOV = Shut-off valve (Unit isolation)
LC = Level control (Separator, contactor, flash tank separator, TEG regenerator)
TC = Temperature control (Regenerator fuel gas)
FC = Flow control (TEG circulation, compressor bypass)
PC = Pressure control (FTS pressure, compressor suction/discharge)

TEG = triethylene glycol
FTS = flash tank separator
How Gas Pneumatic Devices Work

[Diagram with labeled components:
- Gas (7.8+ atm)
- Regulated Gas Supply (2.4 atm)
- Process Measurement
- Liquid Level Pressure Temperature Flow
- Weak Pneumatic Signal (1.2 to 2 atm)
- Pneumatic Controller
- Strong Pneumatic Signal
- Valve Actuator
- Control Valve
- Weak Signal Bleed (Continuous)
- Strong Signal Vent (Intermittent)

1 atmosphere (atm) = 0 pounds per square inch gauge (psig) and 14.7 pounds per square inch atmospheric (psia)

1 atm = 1.013 bar and 101.3 kilopascals (kPa)
Methane Recovery from Pneumatic Devices

- Option 1: Replace high-bleed devices with low-bleed devices
- Option 2: Retrofit controller with bleed reduction kits
  - Field experience shows that up to 80% of all high-bleed devices can be replaced or retrofitted with low-bleed equipment
- Option 3: Maintenance aimed at reducing losses
Option 1: Replace High-Bleed Devices

- Most applicable to
  - Controllers: liquid-level and pressure
  - Positioners and transducers

- Suggested action: evaluate replacements
  - Replace at end of device’s economic life
  - Early replacement

Source: www.emersonprocess.com

Fisher Electro-Pneumatic Transducer

Norriseal Pneumatic Liquid Level Controller

Source: www.norriseal.com
Option 1: Cost to Replace High-Bleed Devices

- Costs vary with size:
  - Typical costs range from TMT 2,000 to TMT 8,550 per device
  - Incremental costs of low-bleed devices are modest (TMT 430 to TMT 710)
  - Gas savings often pay for replacement costs in short periods of time (2 to 8 months)

All data based on Partners’ experiences and represented in U.S. economics converted to Turkmen currency.
Option 2: Retrofit with Bleed Reduction Kits

- Applicable to most high-bleed controllers
- Suggested action: evaluate cost-effectiveness as alternative to early replacement
- Retrofit kit costs ~ TMT 1,950
- Payback time ~ 9 months

All data based on Partners’ experiences and represented in U.S. economics converted to Turkmen currency.
Option 3: Maintenance to Reduce Losses

- Applies to all pneumatic devices
- Suggested action: add to routine maintenance procedures
  - Field survey of controllers
  - Where process allows, tune controllers to minimize bleed
Option 3: Maintenance to Reduce Losses (cont’d)

- Suggested action (cont’d):
  - Re-evaluate the need for pneumatic positioners
  - Repair/replace airset regulators
  - Reduce regulated gas supply pressure to minimum
  - Routine maintenance should include repairing/replacing leaking components

- Costs are low
Five Steps for Reducing Methane Emissions from Pneumatic Devices

1. Locate and INVENTORY high-bleed devices
2. ESTABLISH the technical feasibility and costs of alternatives
3. ESTIMATE the savings
4. EVALUATE economics of alternatives
5. DEVELOP an implementation plan
Industry Experience: Marathon Oil (U.S. Production Company)

- Marathon surveyed 158 pneumatic devices at 50 production sites
- Half of the controllers were low-bleed
- High-bleed devices included:
  - 35 of 67 level controllers
  - 5 of 76 pressure controllers
  - 1 of 15 temperature controllers
Industry Experience: Marathon Oil

▪ Marathon measured gas losses total 145 thousand m³/year

▪ Level controllers account for 86% of losses
  – Losses averaged 0.2 m³/hour/device
  – Losses ranged up to 1.4 m³/hour/device (11.9 thousand m³/year)

▪ Concluded that excessive losses can be heard or felt
Industry Experience – Chesapeake Energy

- Level controllers retrofitted with Mizer components
- Hi-flow sampler used to measure emissions reductions from retrofits

- Fisher 2500, 2506
  Retrofit w/ Mizer, bracket, tubing & relay plug

- Invalco 415, 215, 402
  Retrofit w/ Mizer valve, block & gauges

- Cemco/WellMark 6900
  Retrofit w/ Mizer Valve
## Industry Experience – Chesapeake Energy

<table>
<thead>
<tr>
<th>District</th>
<th>Retrofits Done Thru 31-Mar-09</th>
<th>Total Capital (TMT)</th>
<th>Daily Reduction (thousand m³)</th>
<th>Annual Reduction (million m³)</th>
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<tbody>
<tr>
<td>Anadarko</td>
<td>1,264</td>
<td>1,952,500</td>
<td>25.1</td>
<td>9.2</td>
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<tr>
<td>Arkansas</td>
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<td>154,470</td>
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<tr>
<td>Southern Oklahoma</td>
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<td>201,264</td>
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<td>2.8</td>
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<td>W. Mid Continent</td>
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<td>229,647</td>
<td>2.9</td>
<td>0.6</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>2,670</strong></td>
<td><strong>4,165,972</strong></td>
<td><strong>52.9</strong></td>
<td><strong>18.4</strong></td>
</tr>
</tbody>
</table>

Average Installation Cost = TMT 1,545
Using $3.50/MCF (TMT 350/thousand m³), the simple payback is 7 months.

All data based on Partners’ experiences and represented in U.S. economics converted to Turkmen currency.
Lessons Learned

- Most high-bleed pneumatics can be replaced with lower bleed models
- Replacement options save the most gas and are often economic
- Retrofit kits are available and can be highly cost-effective
- Maintenance is low-cost and reduces gas loss
Contacts and Further Information

- More detail is available on these practices and over 80 others online at: epa.gov/gasstar/tools/recommended.html
- For further assistance, direct questions to:

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