Replacing High-Bleed Pneumatic Devices

Lessons Learned from Natural Gas STAR

Small and Medium Sized Producer Technology Transfer Workshop

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Reducing Emissions, Increasing Efficiency, Maximizing Profits

Pneumatic Devices: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions
What is the Problem?

- Pneumatic devices are major source of methane emissions from the natural gas industry
- Pneumatic devices used throughout the natural gas industry
  - Over 250,000 in production sector
  - ~ 13,000 in processing sector
  - 90,000 to 130,000 in transmission sector
Location of Pneumatic Devices at Production Sites

SOV = Shut-off Valve (Unit Isolation)
LC  = Level Control (Separator, Contactor, TEG Regenerator)
TC  = Temperature Control (Regenerator Fuel Gas)
FC  = Flow Control (TEG Circulation, Compressor Bypass)
PC  = Pressure Control (FTS Pressure, Compressor Suction/Discharge)
Methane Emissions

- As part of normal operations, pneumatic devices release natural gas to atmosphere
- High-bleed devices bleed in excess of 6 cf/hr
  - Equates to >50 Mcf/yr
  - Typical high-bleed pneumatic devices bleed an average of 140 Mcf/yr
- Actual bleed rate is largely dependent on device’s design
Pneumatic Device Schematic

Regulator

Gas
100+ psi

Regulated Gas Supply
20 psi

Process Measurement

Weak Pneumatic Signal
3 - 15 psi

Pneumatic Controller

Weak Signal Bleed
Continuous

Strong Signal Vent
Intermittent

Valve Actuator

Process Flow

Control Valve

Reducing Emissions, Increasing Efficiency, Maximizing Profits
### Emissions from Pneumatic Devices

<table>
<thead>
<tr>
<th></th>
<th>Gas Industry</th>
<th>Oil Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>34.9 Bcf</td>
<td>21.7 Bcf</td>
</tr>
<tr>
<td>Processing</td>
<td>0.6 Bcf</td>
<td>---</td>
</tr>
<tr>
<td>Transmission</td>
<td>14.1 Bcf</td>
<td>---</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>49.6 Bcf</strong></td>
<td><strong>21.7 Bcf</strong></td>
</tr>
</tbody>
</table>

Total Gas/Oil: 71.3 Bcf/yr
How Can Methane Emissions be Reduced?

- Option 1: Replace high-bleed devices with low-bleed devices
- Option 2: Retrofit controller with bleed reduction kits
- Option 3: Maintenance aimed at reducing losses

Field experience shows that up to 80% of all high-bleed devices can be replaced or retrofitted with low-bleed equipment.
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

Norriseal
Pneumatic Liquid
Level Controller

Source: www.norriseal.com

Fisher
Electro-Pneumatic
Transducer

Source: www.emersonprocess.com
Option 1: Replace High-Bleed Devices (cont’d)

- Costs vary with size
  - Typical costs range from $700 to $3,000 per device
  - Incremental costs of low-bleed devices are modest ($150 to $250)
  - Gas savings often pay for replacement costs in short periods of time (5 to 12 months)
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 ~ $500

- Payback time ~ 9 months
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

- Cost is low

Source: www.bpe950.com

Becker
Single-Acting
Valve Positioner
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
Suggested Analysis for Replacement

- Replacing high-bleed controllers at end of economic life
  - Determine incremental cost of low-bleed device over high-bleed equivalent
  - Determine gas saved with low-bleed device using manufacturer specifications
  - Compare savings and cost
- Early replacement of high-bleed controllers
  - Compare gas savings of low-bleed device with full cost of replacement
Economics of Replacement

<table>
<thead>
<tr>
<th>Implementation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Replace at End of Life</th>
<th>Early Replacements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pressure Control</td>
</tr>
<tr>
<td>Cost ($)</td>
<td>150 – 250&lt;sup&gt;b&lt;/sup&gt;</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,340</td>
</tr>
<tr>
<td>Annual Gas Savings (Mcf)</td>
<td>50 – 200</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td></td>
<td>228</td>
</tr>
<tr>
<td>Annual Value of Saved Gas ($)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>150 – 600</td>
<td>498</td>
</tr>
<tr>
<td></td>
<td></td>
<td>684</td>
</tr>
<tr>
<td>IRR (%)</td>
<td>97 – 239</td>
<td>129</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Payback (months)</td>
<td>5 – 12</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>

<sup>a</sup> All data based on Partners’ experiences. See Lessons Learned for more information.

<sup>b</sup> Range of incremental costs of low-bleed over high bleed equipment

<sup>c</sup> Gas price is assumed to be $3/Mcf.
Suggested Analysis for Retrofit

- Retrofit of low-bleed kit
  - Compare savings of low-bleed device with cost of conversion kit
  - Retrofitting reduces emissions by average of 90%
## Economics of Retrofit

<table>
<thead>
<tr>
<th></th>
<th>Retrofit&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation Costs&lt;sup&gt;b&lt;/sup&gt;</td>
<td>$500</td>
</tr>
<tr>
<td>Bleed rate reduction (Mcf/device/yr)</td>
<td>219</td>
</tr>
<tr>
<td>Value of gas saved ($/yr)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>657</td>
</tr>
<tr>
<td>Payback (months)</td>
<td>9</td>
</tr>
<tr>
<td>IRR</td>
<td>129%</td>
</tr>
</tbody>
</table>

<sup>a</sup> On high-bleed controllers  
<sup>b</sup> All data based on Partners’ experiences. See Lessons Learned for more information.  
<sup>c</sup> Gas price is assumed to be $3/Mcf.
Suggested Analysis for Maintenance

- For maintenance aimed at reducing gas losses
  - Measure gas loss before and after procedure
  - Compare savings with labor (and parts) required for activity
## Economics of Maintenance

<table>
<thead>
<tr>
<th></th>
<th>Reduce supply pressure</th>
<th>Repair &amp; retune</th>
<th>Change settings</th>
<th>Remove valve positioners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation Cost ($)^a</strong></td>
<td>153</td>
<td>23</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Gas savings (Mcf/yr)</strong></td>
<td>175</td>
<td>44</td>
<td>88</td>
<td>158</td>
</tr>
<tr>
<td><strong>Value of gas saved ($/yr)^b</strong></td>
<td>525</td>
<td>132</td>
<td>264</td>
<td>474</td>
</tr>
<tr>
<td><strong>Payback (months)</strong></td>
<td>3.5</td>
<td>2</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>IRR</strong></td>
<td>343%</td>
<td>574%</td>
<td>--</td>
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</tr>
</tbody>
</table>

^a All data based on Partners’ experiences. See Lessons Learned for more information.

^b Gas price is assumed to be $3/Mcf.
Pneumatic Devices

- Factors affecting economics of replacement
  - Operating cost differential and capital costs
  - Estimated leak rate reduction per new device
  - Price of gas ($/Mcf)

Source: [www.eia.doe.gov](http://www.eia.doe.gov)
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.
Case Study – 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
Marathon Study:
Hear It? Feel It? Replace It!

- Measured gas losses total 5.1 MMcf/yr
- Level controllers account for 86% of losses
  - Losses averaged 7.6 cf/hr
  - Losses ranged up to 48 cf/hr
- Concluded that excessive losses can be heard or felt
Recommendations

- Evaluate all pneumatics to identify candidates for replacement and retrofit
- Choose lower bleed models at change-out where feasible
- Identify candidates for early replacement and retrofits by doing economic analysis
- Improve maintenance
- Develop an implementation plan
Discussion Questions

- To what extent are you implementing this BMP?
- How can this BMP be improved upon or altered for use in your operation(s)?
- What are the barriers (technological, economic, lack of information, regulatory, etc.) that are preventing you from implementing this technology?