Pneumatic Devices
Lessons Learned from Natural Gas STAR

Producers and Processors Technology Transfer Workshop
New Mexico Oil and Gas Association and EPA’s Natural Gas STAR Program
Farmington, NM
February 21, 2006

Pneumatic Devices: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions
Methane Losses: Oil and Natural Gas Production

- Storage Tank Venting: 9 Bcf
- Meters and Pipeline Leaks: 10 Bcf
- Gas Engine Exhaust: 12 Bcf
- Dehydrators and Pumps: 17 Bcf
- Well Venting and Flaring: 18 Bcf
- Other Sources: 21 Bcf
- Pneumatic Devices: 61 Bcf


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 390,000 in production sector\(^1\)
  - \(~13,000\) in processing sector\(^1\)
  - Over 80,000 in transmission sector\(^1\)

\(^1\) - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2003
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)

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)

Liquid Level Pressure Temperature Flow

Pneumatic Controller

Strong Pneumatic Signal

Valve Actuator

Process Flow

Control Valve

Weak Signal Bleed (Continuous)

Strong Signal Vent (Intermittent)
```

**Emissions from Pneumatic Devices**

<table>
<thead>
<tr>
<th></th>
<th>Gas Industry¹</th>
<th>Oil Industry¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>42.4 Bcf</td>
<td>18.6 Bcf</td>
</tr>
<tr>
<td>Processing</td>
<td>0.1 Bcf</td>
<td>---</td>
</tr>
<tr>
<td>Transmission</td>
<td>11.4 Bcf</td>
<td>---</td>
</tr>
<tr>
<td>Total</td>
<td>53.9 Bcf</td>
<td>18.6 Bcf</td>
</tr>
</tbody>
</table>

Total Gas/Oil: 72.5 Bcf/yr

¹ - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2003
How Can Methane Emissions be Recovered?

- 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.norrisel.com

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

- 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 (2 to 8 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
- 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

Suggested Analysis for Replacement

- Replacing high-bleed controllers at end of their economic life
  - End of economic life when major overhaul required
  - 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>Implementation¹</th>
<th>Replace at End of Life</th>
<th>Early Replacements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ($)</td>
<td>150 – 250²</td>
<td>380</td>
</tr>
<tr>
<td>Annual Gas</td>
<td>50 – 200</td>
<td>166</td>
</tr>
<tr>
<td>Savings (Mcf)</td>
<td>500 – 2000</td>
<td>1660</td>
</tr>
<tr>
<td>Annual Value of</td>
<td>500 – 2000</td>
<td>1660</td>
</tr>
<tr>
<td>Saved Gas ($)³</td>
<td>500 – 2000</td>
<td>2280</td>
</tr>
<tr>
<td>IRR (%)</td>
<td>333 – 800</td>
<td>437</td>
</tr>
<tr>
<td>Payback (months)</td>
<td>2 – 4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

¹ - All data based on Partners' experiences. See Lessons Learned for more information.
² - Range of incremental costs of low-bleed over high bleed equipment
³ - Gas price is assumed to be $10/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$^1$</th>
</tr>
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<tbody>
<tr>
<td>Implementation Costs$^2$</td>
<td>$500</td>
</tr>
<tr>
<td>Bleed rate reduction</td>
<td>219</td>
</tr>
<tr>
<td>(Mcf/device/yr)</td>
<td></td>
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<tr>
<td>Value of gas saved</td>
<td>2190</td>
</tr>
<tr>
<td>($/yr)$^3</td>
<td></td>
</tr>
<tr>
<td>Payback (months)</td>
<td>3</td>
</tr>
<tr>
<td>IRR</td>
<td>438%</td>
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</tbody>
</table>

$^1$ - On high-bleed controllers
$^2$ - All data based on Partners’ experiences. See Lessons Learned for more information.
$^3$ - Gas price is assumed to be $10/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>Implementation Cost ($)¹</td>
<td>153</td>
<td>23</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gas Savings (Mcf/yr)</td>
<td>175</td>
<td>44</td>
<td>88</td>
<td>158</td>
</tr>
<tr>
<td>Value of gas saved ($/yr)²</td>
<td>1750</td>
<td>440</td>
<td>880</td>
<td>1580</td>
</tr>
<tr>
<td>Payback (months)</td>
<td>1.0</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>IRR</td>
<td>1144%</td>
<td>---</td>
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</tbody>
</table>

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² - Gas price is assumed to be $10/Mcf.

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Pneumatic Devices

Factors affecting economics of replacement

- Operating cost differential and capital costs
- Estimated leak rate reduction per new device
- Price of gas ($/Mcf)
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/device
  - Losses ranged up to 48 cf/hr/device (420 Mcf/yr)
- 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 these opportunities?
- How could these opportunities be improved upon or altered for use in your operation?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing these practices?