Pneumatic Devices: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions
Methane Losses from Gas Operated Pneumatic Devices

- Pneumatic devices account for:
  - 46% of methane emissions in the U.S. production, gathering, and boosting sectors (excl. offshore operations)


Natural Gas STAR reductions data shown as published in the inventory.
What is the Problem?

- Pneumatic devices are a major source of methane emissions from the O&G industry
- Pneumatic devices are extensively used throughout the O&G industry
- Gas operated devices are common in many O&G facilities worldwide, Argentina not being the exception
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 into the atmosphere.
- High-bleed devices bleed in excess of 2,9 lpm:
  - Equates to >1,45 Mm³ per year
  - Typical high-bleed pneumatic devices bleed an average of 4 Mm³ per year
- The actual bleed rate is largely dependent on the device’s design.
Pneumatic Device Schematic

Regulator

Gas
7+ kg/cm²

Regulated Gas Supply
1.4 kg/cm²

Process Measurement
Liquid Level
Pressure
Temperature
Flow

Weak Pneumatic Signal
(0.2 – 1.05 kg/cm²)

Pneumatic Controller

Weak Signal Bleed (Continuous)
Strong Signal Vent (Intermittent)

Strong Pneumatic Signal

Valve Actuator

Process Flow

Control Valve
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.norriseal.com

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

- Costs vary with size
  - Typical costs range from US$700 to US$3,000 per device
  - Incremental costs of low-bleed devices are modest (US$150 to US$250)
  - At US$ 70.63/Mm³, gas savings often pay for incremental replacement costs in short periods of time (5 to 12 months)
  - Paybacks for outright replacement are longer, more than 2 years
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 ~ US$ 500
- Typical bleed rate of 4.7 Mm³/y @ US$70.63/Mm³
- Payback time ~ 1.5 years
Option 3: Maintenance to Reduce Losses

- Applies to all pneumatic devices
- Suggested action: Enhance 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
Anticipated emissions:

- Typical crude oil treatment facility has 20 control loops (200 pneumatic devices)
- Typical emissions: 5 Mm³/y per control loop for total of 100 Mm³ of gas emitted per year per facility
- Emissions affected by:
  - Type of pneumatic device: intermittent, throttling, high bleed, low bleed

Mitigation Option:
Replace gas operated pneumatics with electric/low loss/compressed air pneumatics
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 the 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

### Early Replacements

<table>
<thead>
<tr>
<th>Implementation&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Replace at End of Life</th>
<th>Early Replacements</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level Control</td>
</tr>
<tr>
<td>Cost (US$)</td>
<td>150 – 250&lt;sup&gt;b&lt;/sup&gt;</td>
<td>380</td>
</tr>
<tr>
<td>Annual Gas Savings (Mm&lt;sup&gt;3&lt;/sup&gt;)</td>
<td>1,5 – 5,5</td>
<td>4,7</td>
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<tr>
<td>Annual Value of Saved Gas (US$)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>100 – 400</td>
<td>332</td>
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<tr>
<td>IRR (%)</td>
<td>60 – 140</td>
<td>80</td>
</tr>
<tr>
<td>Payback (months)</td>
<td>8 – 18</td>
<td>14</td>
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</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 US$ 70.63/Mm<sup>3</sup> (US$2/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 an average of 90 percent
# Economics of Retrofit

<table>
<thead>
<tr>
<th></th>
<th>Retrofit&lt;sup&gt;a&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>Implementation Costs&lt;sup&gt;b&lt;/sup&gt;</td>
<td>US$ 500</td>
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<tr>
<td>Bleed rate reduction</td>
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<tr>
<td>(Mm&lt;sup&gt;3&lt;/sup&gt;/device/year)</td>
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<tr>
<td>Value of gas saved</td>
<td>438</td>
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<tr>
<td>(US$/yr)&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>Payback (months)</td>
<td>14</td>
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<tr>
<td>IRR</td>
<td>79%</td>
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<sup>a</sup> On high-bleed controllers  
<sup>b</sup> All data based on Partners’ experiences. See Lessons Learned for more information.  
<sup>c</sup> Gas price is assumed to be US$ 70,63/Mm<sup>3</sup> (US$2/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>
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<tbody>
<tr>
<td><strong>Implementation Cost (US$)</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>153</td>
<td>23</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>Gas savings (Mm&lt;sup&gt;3&lt;/sup&gt;/yr)</strong></td>
<td>5</td>
<td>1,25</td>
<td>2,5</td>
<td>4,5</td>
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<tr>
<td><strong>Value of gas saved (US$/yr)</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td>350</td>
<td>88</td>
<td>176</td>
<td>316</td>
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<tr>
<td><strong>Payback (months)</strong></td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<tr>
<td><strong>IRR</strong></td>
<td>201%</td>
<td>380%</td>
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<sup>b</sup>Gas price is assumed to be US$ 70.63/Mm<sup>3</sup> (US$2/mcf)
Pneumatic Devices

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

Source: 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 129 Mm³/yr
- Level controllers account for 86% of losses
  - Losses averaged 3.6 lpm
  - Losses ranged up to 22 lpm
- 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 that are preventing you from implementing this technology?
  - technological,
  - economic, regulatory,
  - lack of information, etc.