Pneumatic Controllers and Pumps

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Need for Pneumatic Devices

- There is a need to perform process control functions (open and close valves, etc.) on upstream oil and gas sites.

- Facilities in all sectors tend to automated control functions for safety and efficiency of operations.

- Many oil and gas sites are remote, and natural gas is an available working fluid with enough motive force to enable these control functions to happen reliably.
Pneumatic Emissions in New Mexico

2017 NM O&G Methane Emissions MT's

- Tanks: 4%
- Liquids Unloading: 7%
- Equipment Leaks: 9%
- Pneumatics: 61%
- Other: 19%

NM Pneumatic Controller Methane MT's Emissions

- Permian MT's CH4
- San Juan MT's CH4
- New Mexico MT's CH4
Types of Pneumatic Devices

- **Pneumatic Controllers**
  - Process control devices found throughout the oil and gas value chain as part of the instrumentation to control the position of valves, and may be actuated using natural gas.
  - Types of service include safety shut-down, position, fluid level, pressure, temperature and flow rate.

- **Pneumatic Pumps**
  - Chemical injection pumps inject small volumes of chemicals into wellheads and gathering lines.
  - Diaphragm pumps are positive displacement pumps moving larger volumes of liquids.
Classifications of Pneumatic Controllers

Continuous High Bleed and Continuous Low Bleed

- Vent natural gas at a continuous rate that is above (high bleed) or below (low bleed) 6 scf/hr

Intermittent Vent

- Vent natural gas when the end device needs to move position (actuate)

Images from UT-Austin: http://dept.ceer.utexas.edu/methane2/study/
Typical Pneumatic Controller Flow Diagram
Example configuration in the field

- Liquid Level Sensor (process measurement, inside unit)
- Pneumatic Controller
- Valve and Valve Actuator

Image from UT-Austin
http://dept.ceer.utexas.edu/meth:ane2/study/
Pneumatic Controllers Vary in Appearance and Function

Liquid level controller, www.norrisealwellmark.com

High pressure shutoff valve, www.emerson.com

Valve controller, www.norrisealwellmark.com

Pressure Regulator, www.kimray.com

Temperature controller, www.kimray.com
Pneumatic Pumps

- Use pressurized gas to pump a liquid by changing the volume fluid area by exerting more or less pressure on the fluid section.

- Diagram to the left is a diaphragm pump, which is used for larger liquid volumes.

- Examples:
  - Glycol circulation
  - Corrosion inhibitors
Regulated Under Federal Air Rules: 40 CFR 60, Subpart OOOO/OOOOa

- 40 CFR Part 60, Subpart OOOO requires no new continuous high bleed pneumatics be installed after August 2011
- 40 CFR Part 60, Subpart OOOOa
  - Wellsite pneumatic pumps must control natural gas emissions by 95% if a control device or process is on site and it is feasible to tie in the pump emissions.
  - Chemical injection pumps (piston pumps) do not have control requirements due to their “inherently low emission rates” (preamble printed page 35849)
Methane Emission Estimation for EPA Reporting

Operator supplies count of each type of device at the basin-level

\[ E_{s,i} = \sum_{t=1}^{3} \text{Count}_t \times EF_t \times GHG_i \times T_t \]

Percent methane in gas

Required EPA Emissions Factors per Device

<table>
<thead>
<tr>
<th>Onshore petroleum and natural gas production and Onshore petroleum and natural gas gathering and boosting</th>
<th>Emission factor (scf/hour/component)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Continuous Bleed Pneumatic Device Vents(^2)</td>
<td>1.39</td>
</tr>
<tr>
<td>High Continuous Bleed Pneumatic Device Vents(^2)</td>
<td>37.3</td>
</tr>
<tr>
<td>Intermittent Bleed Pneumatic Device Vents(^2)</td>
<td>13.5</td>
</tr>
<tr>
<td>Pneumatic Pumps(^3)</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Hours operated per year, default is 8760.
# Selection of Recent Field Studies

<table>
<thead>
<tr>
<th>Study Name</th>
<th># Pneumatic Controllers in Study</th>
<th>Application</th>
<th>Duration of Measurement</th>
<th>Average Whole gas Emission Rate (scf/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDF/UTexas 2014</td>
<td>377</td>
<td>Well pads natural gas production, several U.S. basins</td>
<td>15 minutes</td>
<td>• 5.5 - all sites</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• 5.8 - Midcontinent (region with Permian)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• 0.8 - Rockies (region with San Juan)</td>
</tr>
<tr>
<td>EPA - Thoma Utah Study 2016</td>
<td>80</td>
<td>Uintah Basin well pads (Utah), oil and gas production</td>
<td>1 hour or more</td>
<td>0.36</td>
</tr>
</tbody>
</table>
Retrofit or replace continuous high bleed pneumatic controllers

Run pneumatic controllers on compressed air on oil well sites with multiple controllers and with access to reliable electricity.

In limited situations, mechanical valves can be used without a pneumatic controller to control liquid level. Mechanical valve without a pneumatic controller may not be sufficient for some liquid level process such as when there is a larger process flow or pressure. Retrofit is not feasible.

Route gas from pneumatic pumps to a control device or process if a low pressure control device or process is available on site and in close proximity.
Questions?