Efficient Pigging of Gathering Lines

Lessons Learned from Natural Gas STAR

Processors Technology Transfer Workshop

Gas Processors Association,
Devon Energy, Enogex
Dynegy Midstream Services, and
EPA’s Natural Gas STAR Program

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Agenda

- Methane Losses from Pipeline Pigging
- Methane Recovery
- Industry Experience
- Is Recovery Profitable?
- Discussion Questions
Natural Gas and Petroleum Industry Emissions

- Processing plants responsible for 36 Bcf of methane emissions annually, and gathering/booster stations contribute >22 Bcf

- Transmission & Storage: 98 Bcf
- Production/Gathering/Booster: 150 Bcf
- Distribution: 73 Bcf
- Oil Downstream: 2 Bcf
- Processing: 36 Bcf
- Oil Downstream: 1 Bcf
- Distribution: 10 Bcf
- Transmission & Storage: 18 Bcf
- Oil Downstream: 2 Bcf

Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2002

Reducing Emissions, Increasing Efficiency, Maximizing Profits
Pigging Gathering Lines

- Hydrocarbons and water condense inside wet gas gathering lines, causing pressure drop and reducing gas flow
- Periodic line pigging removes liquids and debris to improve gas flow
- Efficient pigging:
  - Keeps pipeline running continuously
  - Keeps pipeline near maximum throughput by removing debris
  - Minimizes product losses during launch/capture

http://www.girardind.com/
Pigging Applications

Pipeline pigs come in a variety of shapes and sizes for different applications:

- **Cleaning pigs**
  - Have brushes or blades to help remove debris
- **Sealing pigs**
  - Make tight seal for removing liquids from the pipe
- **Inspection pigs**
  - Specialized pigs outfitted with instruments to monitor the pipeline integrity

www.westernfilterco.com
Pigging and Methane Losses

- Gas lost when launching and receiving a pig
- Fugitive emissions from pig launcher/receiver valves
- Gas lost from storage tanks receiving condensate removed by pigging
- Gas vented from pipeline blowdowns
How Does Pigging Vent Methane?

★ Gathering lines have built-in pig launchers
★ Pig launchers have isolation valves for loading pigs, pressurizing pigs, and launching pigs with gas bypassed from the pipeline
★ Launcher pressuring/depressuring loses methane out the vent valve

http://www.girardind.com/
Pigging Vents Methane Twice!

- Methane lost through vent valve on the launcher and again through vent valve on the receiver

- Once receiver is isolated from the line, it must be depressured to remove the pig

- Liquids ahead of the pig drain to a vessel or tank

- Isolation valve leaks cause excessive venting to depressure

http://www.girardind.com/
Estimating Pigging Vents

\[ E = \frac{P \times V}{14.7 \times n \times f} \]

where:
- \( E \) = methane emissions (cubic feet)
- \( P \) = Gathering line pressure (psia)
- \( V \) = Launcher and receiver volume (cubic feet)
- \( n \) = % methane
- \( f \) = number of piggings

★ Pig trap isolation valve leakage increases this minimum amount of gas venting
Estimating Emissions from Pigging

- **Estimating V**

<table>
<thead>
<tr>
<th>Line Diameter (inches)</th>
<th>V (cf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.9</td>
</tr>
<tr>
<td>12</td>
<td>4.6</td>
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<tr>
<td>18</td>
<td>11.5</td>
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<tr>
<td>26</td>
<td>27.7</td>
</tr>
<tr>
<td>34</td>
<td>65.2</td>
</tr>
<tr>
<td>48</td>
<td>170.7</td>
</tr>
</tbody>
</table>

- **Estimating n**
  - Default: 78.8

- **Estimating P**
  - Default: 315 psia

Adapted from http://www.pigsunlimited.com
Gas Recovery from Pipeline Condensate Storage Tanks

- Pressurized condensate collected from pigging is sometimes stored in atmospheric tanks.
- Gas released during atmospheric flashing can be recovered using a vapor recovery unit (VRU) rather than venting the gas.
- Facilities with existing pigging and liquid storage capabilities can install an electric or gas powered VRU compressor to recover flashed gasses.
Industry Experience

- One partner pigged gathering lines 30 to 40 times per year, collecting several thousand barrels of condensate per application.
- Partner reported saving 21,400 Mcf/yr from recovering flash gases.
- Dedicated VRU was installed with an electric compressor.
Is Recovery Profitable?

- Partner reported installation cost of $24,000 for electric VRU compressor
- Annual operating cost of $40,000 mostly electricity
- Large gas savings and increasing gas prices will offset costs

<table>
<thead>
<tr>
<th>Gas Price ($/Mcf)</th>
<th>2.00</th>
<th>3.00</th>
<th>4.00</th>
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</thead>
<tbody>
<tr>
<td>Gas Saved (Mcf/yr)</td>
<td>21,400</td>
<td>21,400</td>
<td>21,400</td>
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<tr>
<td>Annual Savings ($/yr)</td>
<td>42,800</td>
<td>64,200</td>
<td>85,600</td>
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<tr>
<td>Installed Cost</td>
<td>24,000</td>
<td>24,000</td>
<td>24,000</td>
</tr>
<tr>
<td>Operating Cost</td>
<td>40,000</td>
<td>40,000</td>
<td>40,000</td>
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<tr>
<td>Payback Period (years)</td>
<td>8.6</td>
<td>1.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Use Inert Gases and Pigs to Perform Pipeline Purges

★ Pipeline maintenance requires pipe section blowdown before work can begin
★ Gas in pipeline is usually vented to the atmosphere
★ Inert gas can be used to drive a pig down the section of pipe to be serviced, displacing the natural gas to a product line rather than venting
★ Inert gas is then blown down to the atmosphere, avoiding methane loss
Inert Gas Setup

★ Existing pig launcher can be used, set up to work with inert gases
★ Portable nitrogen supply connected to the pig launcher vent
★ Close valve on the main pipeline, pressurize launcher with inert gas, open launcher to main pipeline
★ Supply nitrogen until pig reaches receiver

http://www.girardind.com/
Industry Experience

- One partner reported using inert gas to purge six pipelines for maintenance
- Gas savings from these applications was 538 Mcf
- These savings correspond to a typical application of:
  - 2 miles of 10” diameter pipeline
  - Nitrogen at 280 psi
Is Recovery Profitable?

- No capital costs with existing pigging facilities
- Labor costs are estimated at eight hours for two operators
- Nitrogen costs are roughly $8/Mcf
- Increased safety is the primary benefit of this opportunity
- Gas savings are a secondary benefit, as the labor and nitrogen costs outweigh the gas value
Discussion Questions

★ What opportunities do you have to reduce methane emissions from your pigging operations?
★ How can this presentation be made more useful to help you identify and evaluate opportunities?
★ What are the barriers to your implementing the technologies and practices in this presentation?