Pipeline Maintenance and Repair: Agenda

- Methane Losses from Pipeline Maintenance
- Methane Recovery from Hot Taps
- Methane Losses from Major Pipeline Repairs
- Methane Recovery Using Pipeline Pumpdowns
- Methane Recovery from Pipeline Pigging
- Discussion Questions
Methane Losses from Current Pipeline Maintenance Practices

- Natural gas is often vented to the atmosphere when performing pipeline repairs and new connections
  - Up to 170 thousand cubic meter (Mm³) natural gas vented when making a new connection or non-leaking repairs
  - Quantity depends on pipe diameter, length between isolation valves and operating pressure

- These practices have typically resulted in methane emissions
  - Loss of sales
  - Service disruption and customer inconvenience
  - Costs of gas-freeing the existing piping system

*pipelines range from 10 to 46 centimeters diameter, 3 to 16 km between valves and operating pressure between 7 to 68 atm.
Methane Recovery: Hot Taps for New Connections

- Connecting pipelines without service disruption or methane emissions

Certified Williamson Industries Technician performing a hot tap with a 760 Tapping Machine as part of a 12” Stopple application.

Source: Williamson Industries Inc.
Hot Tapping Procedure

- Connect branch fitting and permanent valve on the existing pipeline while in service
- Install hot tapping machine on the valve
- Cut through pipeline wall and extract coupon through the valve
- Close valve and remove hot tapping machine
- Connect branch line
Hot Tap Benefits

- Continuous system operation – shutdown and service interruptions are avoided
- No gas released to the atmosphere
- Avoided cutting, realignment and re-welding of pipeline sections
- Avoid inerting / gas-freeing pipeline section for hot work
- Reduced planning and coordination costs
- Increased worker safety
Methane Losses from Major Repairs

- Not always possible to repair a pipeline without taking it out of service
- Major pipeline repairs often involve isolating the repair area and venting gas to the atmosphere
  - Major repairs
  - Internal defects
  - Leak repairs
  - Installing large connections
- 1 to 170 Mm$^3$* natural gas vented to the atmosphere with each repair

*on pipelines ranging from 10 to 46 centimeters inside diameter, 16 km between isolation valves and 7 to 68 atm.
Industry Experience

- One hot tap vendor reported helping a gas transmission client avoid a service outage
  - One day gas delivery in a 91-cm natural gas pipeline operating at 68 atm is worth US$243,000 in gross revenue
  - Performing a shutdown connection required 4 days
  - Revenue savings was estimated at US$972,000
Methane Recovery Using Pipeline Pumpdowns

- Minimizing emissions when you must cut out a section of pipeline

Source: Duke Energy
Pipeline Pumpdown Procedure

- Use in-line compressors to “pull down” the pressure to minimum suction pressure
- Use portable compressor to “pull down” pressure even further
- Cost is justified by immediate payback in gas savings
- About 90% of gas usually vented is recoverable
Sequence of Depressurization Events

1. Identify Pipeline Segment Needing Repair
   - Pipeline → Compressor Block Valued Open → Compressor Block Valued Open → Pipeline

2. Depressurize Segment by 50% Using In-line Pipeline Compressor
   - Pipeline → Compressor Block Valued Closed → Compressor Block Valued Open → Pipeline

3. Depressurize Segment Further to 90% Using Portable Compressor In Sequence With an In-line Compressor
   - Pipeline → Compressor Block Valued Closed → Compressor Block Valued Closed → Pipeline

Legend:
- Normal pipeline pressure
- Pipeline with pressure reduced to 50%
- Pipeline with pressure reduced to 90%

Portable Compressor
Pipeline Pumpdown Equipment

- **In-line pipeline compressor**
  - Typically has compression ratio of 2 to 1
  - Blocking upstream valve reduces pipeline pressure with no additional equipment costs

- **Portable compressor**
  - Typically has compression ratio of 5 to 1
  - Can be used in conjunction with in-line compressor to further reduce pressure in the pipeline section
  - Justifiable only when multiple sections of pipeline are to be serviced (i.e. long sections of maintenance or pipeline valve station maintenance where stopples are not feasible)
Economics of Pipeline Pumpdown

- Calculate gas vented to atmosphere by depressuring pipeline
- Calculate gas saved with in-line compressors
- Calculate gas saved with portable compressor
  - Consider cost of a portable compressor
  - O&M costs of a portable compressor
  - Consider fuel costs for operating portable compressor
- Calculate the net gas savings
Pipeline Pumpdown in Argentina

- Over 24,900 km of gas pipelines in Argentina; currently gas transmission companies do not appear to employ pipeline pumpdown as a maintenance activity.
- Pipeline pumpdown using portable compressors is a viable opportunity.
- Example vendors of portable compressors with presence in Argentina:
  - Ariel Compressors
  - Knox Western
Industry Experience

- U.S. Natural Gas STAR partner Southern Gas used compressors three times at one location
- Estimated total cost = US$52,600
- Gas saved from being vented = 922 Mm³
- Gross savings at Argentina price* = US$65,100
- Net savings = US$12,500
- Even at Argentina gas price, practice pays back immediately

*Argentina gas price assumed to be US$70,63 per thousand cubic meter.
Methane Recovery from Pipeline Pigging

- 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
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 pig launcher, and launching pigs with gas bypassed from the pipeline
- Launcher depressuring for inserting a pig vents methane to the atmosphere

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

- Methane is vented from the launcher and again from the pig 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

- More than twice:
  - Isolation valve leaks may cause excessive venting to depressure

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

- \[ E = P \times V \times n \times f \]

where:
- \( E \) = methane emissions (m³)
- \( P \) = Gathering line pressure (atm)
- \( V \) = Launcher and receiver volume (m³)
- \( n \) = % methane
- \( f \) = number of piggings

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

- Estimating \( n \)
  - Default = 78.8
- Estimating \( P \)
  - Default = 21.43 atm
- Estimating \( V \)

<table>
<thead>
<tr>
<th>Line Diameter (cm)</th>
<th>V (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in</td>
<td>15.24</td>
</tr>
<tr>
<td>12 in</td>
<td>30.48</td>
</tr>
<tr>
<td>18 in</td>
<td>45.72</td>
</tr>
<tr>
<td>26 in</td>
<td>66.04</td>
</tr>
<tr>
<td>34 in</td>
<td>86.36</td>
</tr>
<tr>
<td>48 in</td>
<td>121.92</td>
</tr>
</tbody>
</table>

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

- Pressurized condensate collected from pigging is normally transferred to an atmospheric (fixed roof) tank.
- 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.
- Pig receiver vent can also be piped to the VRU for additional gas savings.
Industry Experience

- One partner pigged gathering lines 30 to 40 times per year, collecting several thousand barrels of condensate per application
- Partner reported saving 606 Mm³/year
- Dedicated vapor recovery unit (VRU) was installed with an electric compressor
- Large gas savings and rising gas prices offset costs

<table>
<thead>
<tr>
<th></th>
<th>Gas Price (US$/Mm³)</th>
<th>Gas Saved (Mm³/year)</th>
<th>Annual Savings (US$/year)</th>
<th>Installed Cost (US$)</th>
<th>Operating Cost (US$/year)</th>
<th>Payback Period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70.63</td>
<td>606</td>
<td>42.800</td>
<td>24.000</td>
<td>40.000</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>105.94</td>
<td>606</td>
<td>64.200</td>
<td>24.000</td>
<td>40.000</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>141.26</td>
<td>606</td>
<td>85.600</td>
<td>24.000</td>
<td>40.000</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Discussion Questions

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