Science Based Development of a DI&M Program

Methane to Markets Partnership Technology Transfer Workshop
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Regulatory Context

- Fugitive emissions management is a regulatory requirement for the upstream oil and natural gas industry in Alberta (ERCB Directive 60):
  - Operators must develop and implement a program to detect and repair leaks.
    - These programs must meet or exceed the CAPP Best Management Practice for Fugitive Emissions Management.
  - Operators must use pressurized tank trucks or trucks with suitable and functional emission controls when transporting sour fluids from upstream petroleum industry facilities.

- ERCB Response:
  - Purchased IR camera and has established its own inspection team.
  - Checks to see that companies are implementing their FEM plans.
  - Plans to review industry’s response to the BMP at the end of 2009.
Leak Characteristics

- Contribute significantly to total CH$_4$ emissions at natural gas facilities.

- Only a few percent of the components actually leak.

- Most of the leakage is usually from just a few big leakers.

- Different types of components have different leak potentials and wear out at different rates.

- Components in sour or odorized service tend to leak less than those in sweet or unodorized service.
Fugitive Emissions

- Distribution of opportunities is skewed.
- Few sources are responsible for majority of emissions-focus efforts on these sources first.
Opportunities are Greatest at Older Facilities: Average Emissions vs Age
Reasons for Big Leaks

- Flaws, improper installation, damage, and progressive deterioration.
- Severe/demanding applications coupled with high cost or difficulty of repairs.
- Lack of leak checks after maintenance activities.
- Unnoticed leaks because they occur in difficult-to-access, low-traffic, crowded or noisy areas.
- Lack of measurement data to build a business case.
Average Leak Trends at 9 Gas Plants and 9 Upstream Compressor Stations

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Components Surveyed</th>
<th>Leak Frequency (%)</th>
<th>Emissions From All Leaking Sources</th>
<th>Contribution to THC Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>THC ($10^3$ m$^3$/y)</td>
<td>CH4 (tonnes/y)</td>
</tr>
<tr>
<td>Gas Plants</td>
<td>16 547</td>
<td>2.5</td>
<td>1 680</td>
<td>924</td>
</tr>
<tr>
<td>Compressor Stations</td>
<td>2 478</td>
<td>1.5</td>
<td>146</td>
<td>85</td>
</tr>
</tbody>
</table>
What is Normal Practice?

- Perform a leak check (using a bubble test or hand held gas sensor) on equipment components when first installed and after inspection and maintenance.

- Thereafter, leaks are detected by:
  - Area or building monitors.
  - Personal monitors.
  - Olfactory, audible or visual indicators.

- Leaks are fixed if it is easy to do or they pose a safety concern.

- Unmanned facilities get less attention than manned facilities.

- Priority following a facility turnaround is to get it back online rather than ensure all affected components have been leak checked.
What is Directed Inspection & Maintenance or DI&M?

- It is a practicable ongoing approach to achieving significant cost-effective reductions in fugitive equipment leaks:
  - Find the big leaks in an efficient manner:
    - Focus efforts on the most likely sources of big leaks with coarse or less frequent screening of other components.
  - Only repair components that are cost-effective to repair or pose a safety or environmental concern.
  - Minimize the potential for big leaks and provide early detection and repair of these when they occur.
What is DI&M?

- Implement repairs as soon as possible, or at the next facility turnaround if a major shutdown is required.
- Check for leaks after maintenance or adjustment of equipment.
- Consider leakage directly to the atmosphere as well as into vents, flares and blowdown systems.
What are the Benefits?

- Practicable, less expensive alternative to LDAR.
- Resource conservation.
- Increased revenue.
- Cost-effective
- Improved system reliability.
  - Reduced downtime.
  - Potentially reduced maintenance costs through early detection of problems.
- Safer work place.
- Improved environmental performance.
- Best-in-Class recognition.
### Where Should Efforts be Focused?

#### Sample Leak Statistics for Gas Transmission Facilities

<table>
<thead>
<tr>
<th>Source</th>
<th>Number of Sources</th>
<th>Leak Frequency</th>
<th>Average Emissions (kg/h/source)</th>
<th>Percent of Component Population</th>
<th>Contribution to Total Emissions (%)</th>
<th>Relative Leak Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressurized Station or Unit Blowdown System</td>
<td>219</td>
<td>59.8</td>
<td>3.41E+00</td>
<td>0.131</td>
<td>53.116</td>
<td>7616</td>
</tr>
<tr>
<td>Compressor Seal – Centrifugal</td>
<td>103</td>
<td>64.1</td>
<td>1.27E+00</td>
<td>0.062</td>
<td>9.310</td>
<td>2838</td>
</tr>
<tr>
<td>Compressor Seal – Reciprocating</td>
<td>167</td>
<td>40.1</td>
<td>1.07E+00</td>
<td>0.100</td>
<td>12.764</td>
<td>2400</td>
</tr>
<tr>
<td>Pressure Relief Valve</td>
<td>612</td>
<td>31.2</td>
<td>1.62E-01</td>
<td>0.366</td>
<td>7.062</td>
<td>362</td>
</tr>
<tr>
<td>Open-Ended Line</td>
<td>928</td>
<td>58.1</td>
<td>9.18E-02</td>
<td>0.555</td>
<td>6.070</td>
<td>205</td>
</tr>
<tr>
<td>Orifice Meter</td>
<td>185</td>
<td>22.7</td>
<td>4.86E-02</td>
<td>0.111</td>
<td>0.641</td>
<td>109</td>
</tr>
<tr>
<td>Control Valve</td>
<td>782</td>
<td>9</td>
<td>1.65E-02</td>
<td>0.468</td>
<td>0.919</td>
<td>37</td>
</tr>
<tr>
<td>Pressure Regulator</td>
<td>816</td>
<td>7</td>
<td>7.95E-03</td>
<td>0.488</td>
<td>0.462</td>
<td>18</td>
</tr>
<tr>
<td>Valve</td>
<td>17029</td>
<td>2.8</td>
<td>4.13E-03</td>
<td>10.190</td>
<td>5.011</td>
<td>9</td>
</tr>
<tr>
<td>Connector</td>
<td>145829</td>
<td>0.9</td>
<td>4.47E-04</td>
<td>87.264</td>
<td>4.644</td>
<td>1</td>
</tr>
<tr>
<td>Other Flow Meter</td>
<td>443</td>
<td>1.8</td>
<td>9.94E-06</td>
<td>0.265</td>
<td>0.000</td>
<td>0.02</td>
</tr>
</tbody>
</table>
# Suggested Monitoring Frequencies

## Component Specific Suggested Leak Monitoring Frequencies

<table>
<thead>
<tr>
<th>Source Category</th>
<th>Type of Component</th>
<th>Service</th>
<th>Application</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Equipment</td>
<td>Connectors and Covers</td>
<td>All</td>
<td></td>
<td>Immediately after any adjustments and once every 5 years thereafter.</td>
</tr>
<tr>
<td></td>
<td>Control Valves</td>
<td>Gas/Vapour/LPG</td>
<td></td>
<td>Annually.</td>
</tr>
<tr>
<td></td>
<td>Block Valves – Rising Stem</td>
<td>Gas/Vapour/LPG</td>
<td>All</td>
<td>Annually.</td>
</tr>
<tr>
<td></td>
<td>Block Valves – Quarter Turn</td>
<td>Gas/Vapour/LPG</td>
<td>All</td>
<td>Once every 5 years.</td>
</tr>
<tr>
<td></td>
<td>Compressor Seals</td>
<td>All</td>
<td>All</td>
<td>Quarterly.</td>
</tr>
<tr>
<td></td>
<td>Pump Seals</td>
<td>All</td>
<td>All</td>
<td>Quarterly.</td>
</tr>
<tr>
<td></td>
<td>Pressure Relief Valves</td>
<td>All</td>
<td>All</td>
<td>Annually.</td>
</tr>
<tr>
<td></td>
<td>Open-ended Lines</td>
<td>All</td>
<td>All</td>
<td>Annually.</td>
</tr>
<tr>
<td></td>
<td>Emergency Vent and Blowdown Systems$^1$</td>
<td>All</td>
<td>All</td>
<td>Quarterly.</td>
</tr>
<tr>
<td>Vapour Collection Systems</td>
<td>Tank Hatches</td>
<td>All</td>
<td>All</td>
<td>Quarterly.</td>
</tr>
<tr>
<td></td>
<td>Pressure-Vacuum Safety Valves</td>
<td>All</td>
<td>All</td>
<td>Quarterly.</td>
</tr>
</tbody>
</table>

$^1$This category includes systems designed to handle vapour safely and efficiently.
Implementing a DI&M Program

- Establish emissions baseline.
- Target a <2% leak frequency in each component category.
- Establish a facility-specific DI&M plan to include monitoring performance over time.
- Encourage facility personnel to self monitor with particular emphasis on the most likely sources of big leaks.
Implementing a DI&M Program

- Achieve optimum balance between manual, instrumented and contracted solutions.
  - Consider the use of IR cameras and Hi-Flow sampler.
- Prioritize and implement solutions.
- Conduct confirmatory field measurement.
- Achieve real cost-effective emission reductions.
- Document efforts and experiences.
Key Elements of a DI&M Program

- Periodic Comprehensive Leak Surveys.
  - Once every 5 years.
- Targeted quarterly and annual monitoring.
  - Compressor and pump seals.
  - Pressure-vacuum valves on blanketed tanks.
  - Blowdown systems.
  - PRVs, control valves and rising-stem block valves.
Key Elements of a DI&M Program

- Consider permanent instrumented or easy-to-access monitoring systems.
  - For difficult-to-access sources with high leak potentials.
- Leak checks following maintenance or adjustments.
  - Establish as standard practice and be able to document that this is being done.
Wrap up

- Questions?
- Additional Information
- Thank you
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