Natural Gas STAR
Natural Gas STAR 15th Annual Implementation Workshop

Identifying Top Methane Emission Sources in Gas Processing Plants

Clearstone Engineering, Ltd
Reducing Methane Emissions from Gas Processing Plants - Outline

- Emission Reduction
  - Opportunities
  - Barriers
- Conduct a Facility Review
- Field Measurement Results
- Conclusions and Findings
Opportunities to Reduce Methane Emissions

- There are significant opportunities to address major leak sources and cost-effectively reduce methane emissions
  - Improvements in energy efficiency
    - up to 15%
  - Reduce fugitive emissions
    - up to 70%
  - Reduce venting and flaring emissions
    - between 50 to 70%

- Significant gas savings and marketable carbon credits offset implementation costs
Barriers and Challenges to Successful Implementation

- Lack of measurement data needed to assess opportunities and develop a business case
- Competition with other more traditional investment opportunities for available capital resources
- Operational constraints (declining throughput, age and condition of facilities)
- Ability to measure and track success (Key Performance Indicators)
How To Conduct a Facility Review?

- Target facilities likely to offer significant opportunities
  - Older facilities
  - Natural gas facilities with compression
  - Facilities with high energy intensities and/or process shrinkage

- Use a multi-disciplinary team approach to quantify all emission sources (equipment and process)
  - Take full advantage of the team while they are at the site

- Evaluate, select and prioritize technologies and practices to reduce methane emissions
How To Conduct a Facility Review?

- Conduct baseline survey/field Measurement
- Identify and document reduction opportunities
- Prioritize and implement solutions
- Conduct confirmatory field measurement
- Develop a long term plan to monitor performance
- Record activities and report annually to Natural Gas STAR
Distribution of Losses by Source Category

Leaking Components 53.10%

- Flare Systems 24.40%
- Storage Tanks 11.80%
- Amine Vents 0.50%
- Combustion Equipment 9.90%

Non Leaking Components 0.10%
Fugitive Emissions

- Distribution of opportunities is skewed
- Few sources are responsible for majority of emissions - focus efforts on these sources first
Distribution of Losses from Equipment Leaks by Type of Component

- Compressor Seals: 23.40%
- Connectors: 24.40%
- Valves: 26.00%
- OELs: 11.10%
- Orifice Meters: 0.10%
- Pressure Regulators: 0.40%
- Pump Seals: 1.90%
- Blowdowns: 0.80%
- Pressure Relief Valves: 3.50%
- Control Valves: 4.00%
- Other Flow Meters: 0.20%
Fugitive Emissions

Top Sources

- Compressor seals (34% leak)
- OELs (20% leak)
- Fuel service components (18% leak)
## How Much Methane is Emitted?

### Summary of Natural Gas Losses from the Top Ten Leak Sources (excluding leakage into flare systems)

<table>
<thead>
<tr>
<th>Plant Number</th>
<th>Gas Losses from Top 10 Leak Sources (Mcf/day)</th>
<th>Gas Losses From All Leak Sources (Mcf/day)</th>
<th>Contribution By Top 10 Leak Sources (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>43.8</td>
<td>122.5</td>
<td>35.7</td>
</tr>
<tr>
<td>2</td>
<td>133.4</td>
<td>206.5</td>
<td>64.6</td>
</tr>
<tr>
<td>3</td>
<td>224.1</td>
<td>352.5</td>
<td>63.6</td>
</tr>
<tr>
<td>4</td>
<td>76.5</td>
<td>211.3</td>
<td>36.2</td>
</tr>
<tr>
<td>Combined</td>
<td>477.8</td>
<td>892.8</td>
<td>50.02</td>
</tr>
</tbody>
</table>
Storage Tank Emissions

- Top Sources
  - Flashing losses
  - Unintentional gas carry-through to storage tanks
    - Leakage past the seats of drain and dump valves
    - Malfunctioning level controllers
    - Inefficient upstream gas/liquid separation
    - Piping changes resulting in unstabilized product going to tanks
  - Malfunctioning vapor recovery systems
    - Faulty blanket gas regulators or pressure controllers
    - Fouled vapor collection lines
    - Leaking pressure-vacuum valves and thief hatches
    - Undersizing of systems
### Storage Tank Emissions

#### Field Measurement Results

<table>
<thead>
<tr>
<th>Facility</th>
<th>Methane Emissions ($10^3$M$^3$/year)</th>
<th>Value of Lost Gas (Based on $7$/Mcf/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant C</td>
<td>57</td>
<td>441,371</td>
</tr>
<tr>
<td>Plant E</td>
<td>93</td>
<td>24,559</td>
</tr>
<tr>
<td>Plant H</td>
<td>2,651</td>
<td>1,880,267</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,801</td>
<td>2,346,197</td>
</tr>
</tbody>
</table>
Venting and Flaring Emissions

Top Sources

- Gas operated devices
- Still column off gas vents on glycol dehydrators
- Leakage into vent/flare headers
- Excessive purge gas rates
- Inspection and maintenance activities and pipe tie-ins
Venting and Flaring Emissions

Field Measurement Results

<table>
<thead>
<tr>
<th>Facility</th>
<th>Methane Emissions (10^3 M^3/year)</th>
<th>Value of Lost Gas (Based on $7/Mcf/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant A</td>
<td>3</td>
<td>53,765</td>
</tr>
<tr>
<td>Plant C</td>
<td>28</td>
<td>227,445</td>
</tr>
<tr>
<td>Plant D</td>
<td>18</td>
<td>342.272</td>
</tr>
<tr>
<td>Plant E</td>
<td>14</td>
<td>219,000</td>
</tr>
<tr>
<td>Plant F</td>
<td>66</td>
<td>1,249.588</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>130</strong></td>
<td><strong>2,092,070</strong></td>
</tr>
</tbody>
</table>
Combustion Equipment Emissions

Top Sources

- Oversized engines
- Heaters and boilers
- Poor tuning (e.g., air/fuel ratio)
- Leakage past pistons in engines
- Waste heat utilization to offset duties on heat medium heaters
- Fouled or undersized burner tubes
- Fouled or undersized air intake systems (e.g., fouled flame arrestors)
- Waste heat recovery
Compressor Emissions

Top Sources

- Internal valve and cylinder leakage in reciprocating compressors
- Pulsation losses
- Excessive gas recirculation
IR CAMERA Results

Suction valve (left) in the left picture is leaking.
Discharge valve (right) in the right picture is leaking.
Leaking bypass valve results in leakage from discharge to suction scrubber.
Process Performance Emissions

Top Sources

- Lack of waste heat recovery and heat integration
- Fouled heat exchangers
- Poor process control resulting in increased re-processing, venting and flaring
- Use of low efficiency equipment
- Excessive chemical circulation rates in absorption processes
- Excessive pressure and heat losses
Conclusions and Findings

- Targeted and holistic screening of facilities is the best approach for identifying and prioritizing methane emission reduction activities
- Opportunities vary dramatically between facilities
- Benefits of reducing methane emissions
  - Increased production through reduced losses and fuel consumption
  - Increased revenues.
  - Reduced operating cost.
  - Generate marketable carbon credits
- Improve environmental performance
  - Associated reduction of other pollutants, e.g., H₂S, VOC, NOₓ, SO₂, CO and PM
Wrap up

Questions?

Additional Information
- Natural Gas STAR: epa.gov/gasstar
- Technologies and Practices: epa.gov/gasstar/tools/recommended

Thank you
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