GAS RECOVERY
Optical Fugitive Emission Pilot Study

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Overview

• Background
• Pilot Study Scope
• Summary of Findings
  • Source Data
  • Facility Comparison
  • Economics
• Path Forward
Fugitive Emissions

Losses (leaks) of HC product
(methane, propane, VOC’s)

UNINTENTIONAL FUGITIVES
– normal wear and tear / damage
– improper or incomplete assembly of components
– inadequate material specification
– manufacturing defects

INTENTIONAL FUGITIVES
– venting (tanks, controllers, comp. seals, stacks, etc.)
“Why worry about some little leaks?”

“What is the Problem?”
Gas leaks are invisible, unregulated and go unnoticed
Background

Study Objective
- evaluate new leak detection and measurement technology and determine actual facility fugitive emission rates

Drivers
- Increase production & reduce costs by recovering lost gas
- CAPP Fugitive Emission Management BMP
- Increase operations Health & Safety
- Reduce GHG emissions / Carbon Credits
- Part of CPC E/E, Gas Star Program, and BIC Initiative
Background

Detection Technology
- **GasfindIR** - optical emission technology
  - infrared video camera with hydrocarbon/VOC filter
  - provides visible images of a HC gas emissions in real-time

Benefits:
- Rapid, accurate and safe detection
- Scan hard-to-reach components from a distance
- Assessments performed without interruption of operations
- Inspection times are minimal, which can keep costs down.
- With exact leak source info, repairs are less time consuming and less expensive.
- Cost-effectively scan hundreds of components simultaneously

Approx. Cost: $75,000.00USD
Background

Measurement Technology

• HiFlow Sampler – volumetric leak measurement
  – vacuum flow rate detection uses dual-element hydrocarbon (methane) detector
  – measures hydrocarbon concentrations in the captured air stream and determines the leak flow rate (+- 10%)

Benefits:

– offers a much higher accuracy of measurement (compared to conventional methods)
– allows an objective cost-benefit analysis of each repair opportunity

Approx. Cost:
$14,000 USD
SCOPE

• Evaluate 22 facilities (9 gas plants and 13 comp. stns.) from various asset areas
• Obtain fugitive emission data
• Complete repair cost/benefit analysis
• Create recommendations for applying a Canada-wide program (CAPP BMP)
SOURCE INFO

# of Sources
- 77% leaking components (111)
- 23% other fugitive emission sources (33)
- 92% economical to repair (133)

Composition
- 75% Process gas (108)
- 21% Fuel gas (30)
- 4% Propane (6)

Location
- 72% Compressor Buildings
- 20% Process Buildings
- 4% Outside piping
- 4% Tanks

ConocoPhillips
GAS PLANT COMPARISON

Throughput (mmcf/year)

Facility

Potential Savings (USD/year)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Throughput (mmcf/year)</th>
<th>Potential Savings (USD/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP #5</td>
<td></td>
<td></td>
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<tr>
<td>GP #9</td>
<td></td>
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<tr>
<td>GP #8</td>
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<tr>
<td>GP #1</td>
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<tr>
<td>GP #2</td>
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<td>GP #7</td>
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<tr>
<td>GP #3</td>
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<tr>
<td>GP #6</td>
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<td>GP #4</td>
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</table>
## ECONOMICS

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Average Yearly Savings/Facility (US$/year)</td>
<td>$16,300.00</td>
</tr>
<tr>
<td>Average Total Cost/Facility (US$/year)</td>
<td>$8,000.00</td>
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<tr>
<td>Average Est. Payout Period (years)</td>
<td>0.50</td>
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<tr>
<td>Total Gross Est. Annual Savings (US$/year)</td>
<td>$10,400,000.00</td>
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<tr>
<td>Total Est. NPV (US$/year)</td>
<td>$35,000,000.00</td>
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<tr>
<td>CO2e/year Reduction (tonnes)</td>
<td>630,000</td>
</tr>
<tr>
<td>CO2e Credit Value (US$)</td>
<td>$15,750,000.00</td>
</tr>
</tbody>
</table>

* Using $5.50 USD/mmbtu and $25.00 USD/tonne CO2e
CAPP BMP CONTROL STRATEGY

• Fugitive Assessment Schedule
  – Company-wide assessment of all facilities

• Fugitive Maintenance Plan
  – Operating procedures and performance objectives for minimizing fugitive emissions
  – Directed Inspection & Maintenance (DI&M) Program
    • Prioritize inspections to target high potential processes and components
  – Influence facility design (i.e. flow meters, low bleed, vapour recovery, etc.)
Table 1. Proposed schedule for implementation of this fugitive emissions BMP.

<table>
<thead>
<tr>
<th>Type</th>
<th>Component Categories Subject to DI&amp;M</th>
<th>Facility</th>
<th>Initial 4-year Schedule</th>
<th>After 4 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Plants</td>
<td>Group Batteries</td>
<td></td>
<td>- ~150 Facilities/ year</td>
<td>- 2 year maintenance-phase schedule</td>
</tr>
<tr>
<td></td>
<td>Single Well Batteries</td>
<td></td>
<td>- Majority of GP in 1st year</td>
<td>- Average assessment times drop due to leak rates decline</td>
</tr>
<tr>
<td>Compressor Stations</td>
<td></td>
<td></td>
<td>- ~ 70 assessment days/year</td>
<td>- Leak-prone facilities will require a higher priority/rate of assessment</td>
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<td></td>
<td>- Coordinate with turn-arounds when possible</td>
<td>- Operators request assessments based on fugitive maintenance findings</td>
</tr>
</tbody>
</table>

- Operators request assessments based on fugitive maintenance findings
PATH FORWARD

• Set schedule to follow CAPP BMP guideline
• Evaluate pipeline opportunities
• Decide on resources
  – i.e. third party, in-house, cost/benefit evaluation
• Develop Fugitive Maintenance Plan
  – Imbed Fugitive Management into Operations and Facility Design
• Education / Knowledge Sharing
QUESTIONS?