METHANE TO MARKETS

Oil & Gas Systems Technology Transfer

FUGITIVE EMISSION MANAGEMENT

Terence Trefiak, P.Eng.

Sept. 15, 2009
OVERVIEW

• BACKGROUND
• DETECTION & MEASUREMENT TECHNOLOGY
• FUGITIVE EMISSION MANAGEMENT PROGRAM (FEMP) COMPONENTS
• FEMP CONSIDERATIONS
• CURRENT AND FUTURE REGULATIONS
• CASE STUDY DATA
UNDERSTANDING THE ISSUE

Fugitive Emissions

• intentional
  ▪ intended/designed venting (i.e. venting from tanks, controllers, compressor seals, stacks, etc.)

• unintentional
  ▪ leaks due to normal wear and tear, improper or incomplete assembly of components, inadequate material specification, manufacturing defects, damage during installation or use, corrosion, fouling and environmental effects

• potentially cost industry hundreds of millions to billions of dollars in lost product and can pose safety risks to workers and the public

• account for a significant amount of the total inventory of greenhouse gases emitted by industry
DRIVERS

**Improving Health & Safety**
- Identify and eliminate hazards (Fire & Explosions and Exposure)
- Reduce LEL (lower explosive limit) levels within facilities

**Maximizing Profits**
- Recover lost product
- Increase production
- Reduce costs

**Reducing Emissions**
- Reduce GHG (methane) emissions
- Reduce BTEX and other VOC emissions
- Solve offsite odor problems

**Maintaining Regulatory Compliance**
- Meet or exceed requirements
- Arm company with new technologies used by regulators
CONVENTIONAL LEAK DETECTION

Gas Sniffer
• US EPA Method 21 using a hydrocarbon detection sensor to obtains ppm, or LEL.
• Ranging from a personal safety monitors to TVA VOC analyzer
• Each connection must be assessed separately

Bubble Test
• Using soap solution on a connection to detect leak

Ultrasonic Testing
• Detects frequency of turbulent flow from leaks
DETECTION TECHNOLOGIES

Primary:
Optical Infrared Detection
ThermaCAM® GasFindIR
  - New leading FE technology
  - Proven and reliable technology
  - Significant increase in ability to find emissions
  - Significant decrease in the time/money needed to assess facilities
  - IR scanning now approved by EPA as alternative to conventional methods

Secondary:
Gas Detector (EC, PID/FID, IR, etc.)
  - Provides ppm level detection of gas leaks
  - Building entry, hazardous gas detection, etc.
  - Supplementary confirmation of emission type, source, and size
DETECTION TECHNOLOGIES

Auxiliary / Specialized:

- **Laser Methane Gas Detector**
  - Long range & Remote detection
  - High sensitivity for Methane (100-10,000 ppm*m)
  - Ultra fast response
  - Use with mobile survey (pipeline)

- **Ultrasonic Internal Valve Leak Detection**
  -detects through-valve leakage based on ultrasonic frequency
  - Quantitative estimation of leak volume
Primary:
- **Hi flow Sampler**
  - very high accuracy and efficiency
  - allows an objective cost-benefit analysis
  - always have at least one backup unit

Secondary:
- **Vane Anemometer**
- **Calibrated volume bag**
- **Flow Meters**
Let us help you “see” what you are missing!

<table>
<thead>
<tr>
<th>What you see...</th>
<th>What we see...</th>
</tr>
</thead>
</table>

www.targetemission.com
THREADED CONNECTION
0.45 ft³/min.
VALVE STEM
0.65 ft³/min.
Pig Trap Cap
3.50 ft³/min.
CONDENSATE TANK VENT EMISSIONS
10.5 ft³/min.
CONDENSATE TANK VENT EMISSIONS
12.0 ft³/min.
DUMP VALVE LEAK (VENT STACK)
OVER 60.0 ft³/min.
HOLE IN BLOCK FLANGE
1.20 ft³/min.
COOLER PIPING LEAK
20.00 ft³/min.
FEMP

Roles and Responsibilities

Communication System

Data Collection Management

QA/QC

COMPREHENSIVE FACILITY ASSESSMENTS

• Baseline selection
• Technology & Resource selection
• Scheduling
• Communication & Follow-up

DIRECTED MONITORING AND PREVENTION

• Priority Monitoring
  • Component Specific
  • Routine
  • Installed
  • Post Modification

• Facility Design & Ops. Standards
COMPREHENSIVE FACILITY ASSESSMENTS

- Facility Baseline Selection (threshold)
- Perform Assessments
- Results Communication
- Set Ongoing Schedule
- Facility & Component Prioritization
- Repair Tracking
IMPORTANT CONSIDERATIONS

**QA/QC** - protocols for procedures, equipment maintenance, data collection and storage, and training

**COMMUNICATION** – effective reporting system to transfer data to individuals responsible for action

**DATA CONSISTENCY** - ensure that all source data is captured and consistently recorded

**AUDITABILITY** – consistent and repeatable results

**VERIFIABLE** - eligible to apply for GHG credits and/or offsets via independent verification (ISO 14064-1, 2, & 3)

**EXPERIENCE** – trained (certified), experienced and tested in the use of fugitive equipment and processes

**HEALTH & SAFETY** – work presents a set of hazards that must be controlled

www.targetemission.com
IMPORTANT CONSIDERATIONS

RESOURCES
- external vs. internal (LODI)
- expertise in emission management
- a good tool is not a program

CORPORATE COMMITMENT
- bottom down approach will help ensure buy-in and follow through of implementation
- the program approach has large impact on success
- Imbed into corporate, facility and individual goal setting

REPAIR TRACKING
- develop a workable tracking system before program implementation
- incorporate existing data management systems
- effective feed-back system for repair tracking
FEMP APPROACHES

BASELINE
- threshold levels vary, but average level is approx. 250 hp
- some starting at larger/older facilities only
- some companies doing wide cross section (wellsite, oil battery, comp. stn, GP)

FREQUENCY
- most companies are following a facility priority system, while other facility plans range from bi-annual to every 3 years

REPAIR TRACKING
- split between existing work order system and external tracking system

RESOURCES
- most companies are using third party, a few have started internal programs
- Operator involvement is low
EPA Proposed Mandatory Greenhouse Gas Reporting Rule (March 10, 2009)
(http://www.epa.gov/climatechange/emissions/ghgrulemaking.html)

W. Oil and Natural Gas Systems

- facilities with emissions **greater than 25,000** metric tons CO2e per year be subject to reporting (**annual leak assessments**)
- identifies relevant facilities and outlines methods and procedures for calculating and reporting fugitive emissions
- fugitive emissions defined as unintentional equipment emissions and intentional or designed releases of **CH4 and CO2**
- propose that facilities would be required to **detect and then quantify** emissions
- Emission Source, Monitoring Method Type, Emissions Quantification Methods
Proposed Mandatory Greenhouse Gas Reporting Rule (cont.)

- lists advantages/disadvantages of specific technologies *(cost-effective detection technologies such as infrared fugitive emissions detection instruments in conjunction with direct measurement methodologies)*
- direct measurement using Method 21 was not found suitable for fugitive emissions measurement under this reporting rule
- engineering estimates only used of variable or unsafe to monitor sources
- the mass balance is often not recommended because of the uncertainties surrounding meter readings and the large volumes of throughput relative to fugitive emissions.
- emissions detected and measured would be assumed to continue throughout the reporting year, unless no emissions detection is recorded at an earlier and/or later point in the reporting period.
## CASE STUDY DATA

<table>
<thead>
<tr>
<th>FACILITY TYPE</th>
<th>#</th>
<th>% OF FACILITY COUNT</th>
<th>% OF TOTAL EMISSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPRESSOR STATIONS</td>
<td>265</td>
<td>60.6%</td>
<td>52.2%</td>
</tr>
<tr>
<td>MULTIWELL OIL BATTERY</td>
<td>91</td>
<td>20.8%</td>
<td>14.6%</td>
</tr>
<tr>
<td>GAS PLANTS</td>
<td>62</td>
<td>14.2%</td>
<td>30.9%</td>
</tr>
<tr>
<td>SINGLE WELL OIL BATTERY</td>
<td>12</td>
<td>2.7%</td>
<td>0.6%</td>
</tr>
<tr>
<td>WELLSITE</td>
<td>5</td>
<td>1.1%</td>
<td>0.4%</td>
</tr>
<tr>
<td>SAGD (Oil Sands)</td>
<td>2</td>
<td>0.5%</td>
<td>1.4%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>437</td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**AVERAGE THROUGHPUT**: 75 e³m³/day
# CASE STUDY DATA

<table>
<thead>
<tr>
<th>Natural Gas (US$/mcf)</th>
<th>TYPE</th>
<th>TOTAL # OF SOURCES</th>
<th>ANNUAL GAS VALUE</th>
<th>CO2e CREDIT VALUE ($15/tonne)</th>
<th>EST. COST OF REPAIRS</th>
<th>NET PRESENT VALUE</th>
<th>ASSESSMENT TIME (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEAKS</td>
<td>2330</td>
<td>$2,016,181</td>
<td>$787,699</td>
<td>$198,080</td>
<td>$3,894,242</td>
<td></td>
<td>157</td>
</tr>
<tr>
<td>VENTS</td>
<td>2513</td>
<td>$6,170,307</td>
<td>$2,494,379</td>
<td>$10,102,080</td>
<td>$14,834,995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>4843</td>
<td>$7,876,988</td>
<td>$3,282,078</td>
<td>$10,300,160</td>
<td>$18,051,432</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE / FACILITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEAKS</td>
<td>5</td>
<td>$4,614</td>
<td>$1,803</td>
<td>$453</td>
<td>$8,911</td>
<td></td>
<td>0.36</td>
</tr>
<tr>
<td>VENTS</td>
<td>6</td>
<td>$14,119</td>
<td>$5,708</td>
<td>$23,117</td>
<td>$33,947</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>11</td>
<td>$18,733</td>
<td>$7,511</td>
<td>$23,570</td>
<td>$42,858</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE / DAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEAKS</td>
<td>15</td>
<td>$12,842</td>
<td>$5,018</td>
<td>$1,262</td>
<td>$24,805</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>VENTS</td>
<td>16</td>
<td>$39,302</td>
<td>$15,887</td>
<td>$64,345</td>
<td>$94,490</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>31</td>
<td>$52,143</td>
<td>$20,905</td>
<td>$65,607</td>
<td>$119,295</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

www.targetemission.com
STATISTICS

• % Economical Leaks (POP <1.5 years) = 92%
• % Economical Vents (POP <1.5 years) = 70%
• % of emissions that are Safety Concern = 4%
• Top 10% of leaks makes up 73% total volume
• Top 10% of vents makes up 62% total volume
CONTACT INFO
PHONE: (403) 225-8755
EMAIL: target@envirotecheng.com
WEBSITE: www.targetemission.com
LEAK GAS STREAM %

- Throughput: 46.0%
- Fuel/supply gas: 28.5%
- Storage tank losses: 17.0%
- Process vent: 7.7%
- Flare: 0.7%
The chart illustrates the distribution of vent process block percentages across various components. The highest percentage is associated with tankage at 49.0%, followed by compressor at 35.2%, and flare/vent system at 17.1%. Other components such as separator/filter, process building, refrigeration system, meter station, inlet/discharge piping, oil treater, and wellhead have lower percentages, with some close to 0%. The chart provides a clear visual representation of the importance of each component in the overall vent process block.
VENT GAS STREAM %

- Storage tank losses: 48.7%
- Fuel/supply gas: 38.2%
- Process vent: 23.2%
- Flare/vent system: 12.8%
VENT COMPONENT %

- tank hatch/vent: 52.8%
- inst./controls: 30.4%
- comp. seal vent: 14.0%
- open-ended line: 5.4%