LDAR Case Study
Comparison of Conventional Method 21 vs Alternative Work Practice (Optical Gas Imaging)

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OVERVIEW

• AWP Components/Requirements
• AWP vs Conventional Comparison
• Case Study Data
METHOD 21 AWP

• Released in 2008 to address new technology - Optical Gas Imaging (OGI)
• Allows facilities to identify leaking equipment using an OGI instrument instead of a leak monitor prescribed in 40 CFR part 60, Appendix A-7 (i.e., a Method 21 instrument)
• Provide for emissions reductions at least as equivalent as the current work practice
• Document provides instructions and requirements for using OGI
DETECTION TECHNOLOGIES

OGI:
FLIR GF 320 or OPGAL EYECGAS
- Uses infrared absorption principles of hydrocarbon gases
- Allows user to actually see the gas images

Conventional:
Gas Detector (EC, FID, PID) & Snoop
- Selection based on compound of interest
- Provides ppm level detection of gas leaks
- Can be used for leak confirmation
AWP REQUIREMENTS

- Modified Monitoring Frequencies
  - Bi-annual on all components

- OGI Performance Testing
  - Daily performance test to determine minimum detection level at maximum camera distance

- Data Recording
  - Must record video of entire inspection

- Leak definition
  - Not based on PPM

- Requires conventional assessment once annually
FREQUENCY

M21 – various leak definitions based on parts per million (ppm) and corresponding monitoring frequencies (monthly, quarterly, or annually)

AWP – Entire facility, based on detection sensitivity level:

<table>
<thead>
<tr>
<th>Monitoring Frequency per Subpart</th>
<th>Detection Sensitivity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-Monthly</td>
<td>60</td>
</tr>
<tr>
<td>Semi-Quarterly</td>
<td>85</td>
</tr>
<tr>
<td>Monthly</td>
<td>100</td>
</tr>
</tbody>
</table>

“increased frequency of monitoring to detect larger leaks to compensate for the camera’s inability to detect small leaks”
OGI DETECTION LIMIT

- Reference rate of 60 grams/hour
- Tests show rates as low as 0.8 grams/hour using methane
- TARGET – average leaks detection minimum ranges from:
  - 300 to 1500 PPM (2.5 g/hr to 10 g/hr)
- Environmental conditions have impact on limit (wind speed, delta T, background scene)
• Minimum Detected leak rate (MDLR)
  • 1-Pentene - 5.6g/hr
  • Benzene - 3.5g/hr
  • Butane - 0.4g/hr
  • Ethane - 0.6g/hr
  • Ethanol - 0.7g/hr
  • Ethylbenzene - 1.5g/hr
  • Ethylene - 4.4g/hr
  • Heptane - 1.8g/hr
  • Hexane - 1.7g/hr
  • Isoprene - 8.1g/hr
  • MEK - 3.5g/hr
  • Methane - 0.8g/hr
  • Methanol - 3.8g/hr
  • MIBK - 2.1g/hr
  • Octane - 1.2g/hr
  • Pentane - 3.0g/hr
  • Propane - 0.4g/hr
  • Propylene - 2.9g/hr
  • Toluene - 3.8g/hr
  • Xylene - 1.9g/hr
PERSPECTIVE

• 1 Medium leak found 6 months earlier with OGI vs M21
• 250,000ppm vs. 500ppm = 500x bigger
• Orders of Magnitude differences in size
• Each med-high OGI leak detected equivalent to hundreds or thousands of small leaks
• Higher frequency = faster detection of high emitters = significant impact on annual emission rates
# METHOD 21 VS AWP

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>CONVENTIONAL</th>
<th>AWP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EQUIPMENT</strong></td>
<td>Hand-held monitors to detect ppm levels of VOC</td>
<td>Optical Gas Imaging to detect visible image of VOC leaks</td>
</tr>
<tr>
<td><strong>WEATHER LIMITS</strong></td>
<td>High rain, wind and humidity</td>
<td>Rain, fog, wind and extreme cold</td>
</tr>
<tr>
<td><strong>LEAK DEFINITION</strong></td>
<td>500 – 10,000 ppm</td>
<td>Visible leak (no quantification)</td>
</tr>
<tr>
<td><strong>ACCESSIBILITY</strong></td>
<td>Maximum 3 meters with probe extension</td>
<td>Maximum over 30 meters with lens</td>
</tr>
<tr>
<td><strong>ACCURACY</strong></td>
<td>High instrument accuracy but prone to technician errors and leak locating errors (one centimeter difference in analyzer position equated to a 57% chance of missing an actual leak)</td>
<td>Very high accuracy as exact leak source can be seen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower accuracy at conc. below 1500 ppm</td>
</tr>
<tr>
<td><strong>EFFICIENCY</strong></td>
<td>250 – 600 components per day</td>
<td>5000 – 15,000 components per day</td>
</tr>
<tr>
<td><strong>FREQUENCY</strong></td>
<td>Monthly, Quarterly, Annual</td>
<td>Bi-monthly, Annual (conventional)</td>
</tr>
<tr>
<td><strong>COST</strong></td>
<td>Higher due to increased time onsite</td>
<td>Approximately 15-30% lower</td>
</tr>
</tbody>
</table>
M21 PITFALLS

Staffing
- Highly competitive mature market has led to low wages and reflects on hiring standards
- Significant inconsistency in performances
- High turnaround and minimal training

Short Cuts
- LDAR industry continuously battles cheating methods
- Monotonous tasks

Tag Program Gaps
- Challenge to keep inventory updated
AWP BENEFITS

• Provides equivalent control and is less burdensome to implement
• Length of assessments lower (less $)
• Able to scan components that were previously unsafe or inaccessible (reduce scaffolding / manlift requirements)
• Can see leak source, preventing leak and repair errors, eliminates “ghost leaks”
• Video image of leak sources and full video record for auditing
• Eliminates the need to calculate different monitoring requirements for different devices simplifying the process
• Leaks detected/repaired sooner, significantly lowering annual emission rates
• **Amount of emissions released by smaller leaks possibly missed by OGI surveys are offset by the faster identification (and repair) of larger leaks when surveys are conducted on a more frequent basis.**
METHOD 21
CONVENTIONAL VS AWP
EPA KKK & OOOO

- **LDAR regulations that applied to NG Processing Facilities**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>KKK</th>
<th>OOOO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable</td>
<td>commence construction, modification or</td>
<td>commence construction, modification or</td>
</tr>
<tr>
<td></td>
<td>reconstruction before August 23, 2011</td>
<td>reconstruction after August 23, 2011</td>
</tr>
<tr>
<td>Components</td>
<td>Excludes connectors</td>
<td>Includes connectors</td>
</tr>
<tr>
<td>Leak Definition</td>
<td>10,000 ppm</td>
<td>500 ppm</td>
</tr>
</tbody>
</table>

- **New OOOO in draft form, CH4 inclusion**
## CASE STUDY

- Regulatory Requirement: EPA Subpart OOOO
- 6 process units
- Over 16,796 components

<table>
<thead>
<tr>
<th>CASE STUDY COMPONENTS</th>
<th>M21</th>
<th>AWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor</td>
<td>14</td>
<td>Q</td>
</tr>
<tr>
<td>Connector</td>
<td>10500</td>
<td>A</td>
</tr>
<tr>
<td>Press Relief Device</td>
<td>146</td>
<td>Q</td>
</tr>
<tr>
<td>Pump</td>
<td>35</td>
<td>M</td>
</tr>
<tr>
<td>Valve</td>
<td>6101</td>
<td>Q</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>16796</td>
<td>12 trips</td>
</tr>
</tbody>
</table>
## CASE STUDY

### Crew, Equipment and Reporting Costs

<table>
<thead>
<tr>
<th>METHOD</th>
<th>M21</th>
<th>M21 AWP - OGI</th>
<th>TOTAL DAYS/ YEAR</th>
<th>CREW AND EQUIPMENT</th>
<th>% SAVINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A,Q,M BI-MONTHLY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AWP</td>
<td>22</td>
<td>3.0</td>
<td>37</td>
<td>$134,800</td>
<td>20%</td>
</tr>
<tr>
<td>M21</td>
<td>50</td>
<td>0.0</td>
<td>50</td>
<td>$170,000</td>
<td></td>
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</tbody>
</table>

Assumes a 17% higher crew and equipment cost for OGI
Does not include indirect repair costs savings
Removing annual M21 requirement would change to 57% cost savings

### METHOD TRAVEL AND SUBSIS. TOTAL % SAVINGS

<table>
<thead>
<tr>
<th>METHOD</th>
<th>TRAVEL AND SUBSIS. TOTAL</th>
<th>% SAVINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWP</td>
<td>$44,400</td>
<td>28%</td>
</tr>
<tr>
<td>M21</td>
<td>$62,000</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>Leak Count</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>AWP</td>
<td>561</td>
<td></td>
</tr>
<tr>
<td>M21</td>
<td>555</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method</th>
<th>Leak Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWP</td>
<td>335</td>
</tr>
<tr>
<td>M21</td>
<td>329</td>
</tr>
</tbody>
</table>
# LEAK COMPARE

## Plant 1

<table>
<thead>
<tr>
<th>Method</th>
<th>Leak Count</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGI</td>
<td>37%</td>
<td>90%</td>
</tr>
<tr>
<td>M21</td>
<td>63%</td>
<td>10%</td>
</tr>
</tbody>
</table>

75% of Rate Connectors

## Plant 2

<table>
<thead>
<tr>
<th>Method</th>
<th>Leak Count</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGI</td>
<td>54%</td>
<td>98%</td>
</tr>
<tr>
<td>M21</td>
<td>46%</td>
<td>2%</td>
</tr>
</tbody>
</table>

75% Rate Connectors

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**EMISSION VOLUME**

- OGI
- M21
OGI USAGE

- EPA Subpart W – recommended and most common technology used
- EPA OOOOa – Transmission sites required to perform OGI LDAR Program
- State Level – numerous State requirements enlisting OGI
- Inspection Tool – Federal and State Regulatpr using OGI for facility inspections
OGI FUTURE

• ERG Draft Technical Support Document
  ▪ OGI history, technology, research, observations, etc.
  ▪ Discusses results of detection limit tests

• A protocol for applying OGI technology will be codified at 40 CFR part 60, appendix K
  ▪ Prescriptive procedures for source characterization and compliance
  ▪ Replace AWP?
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