Leak Detection in Terminal Facility Piping

Ian Harris, Praxair Services, and Sam Adams, Phillips 66, will review strategies for detecting leaks in terminal facility piping, including drain lines, manifold lines, product lines, prover lines and rack lines. They will examine criteria for leak detection and inspection programs and share best practices. Harris will also provide an overview of the tracer gas methodology and share findings from facility tests to illustrate the capabilities and limitations of its application at terminals.

ABOUT THE SPEAKERS

Sam Adams is a maintenance engineer within Phillips 66’s midstream division. His primary job duties include the planning and execution of Phillips 66 integrity driven maintenance projects. This includes pipeline reconditioning and terminal tracer gas leak detection projects. He earned his Bachelor’s degree in Metallurgical Engineering from Missouri University of Science and Technology.

Ian Harris, Business Development at Praxair Services, Inc., has been involved in using "tracer” compounds for integrity assessments for 27 years. His experience includes storage tanks, pipelines, and carbon sequestration applications. Harris studied at the University of Toledo and the University of Arizona.
Leak Detection in Terminal Facility Piping

Sam Adams, Phillips 66
Ian Harris, Praxair Services
Leak Detection Method

- Tracer Gas Assessment
- Tracer-based method using small amounts of inert compounds (“tracers”) to detect small leaks
Tracer Gas Assessment

- Can be performed in-service
- Can detect & locate leaks of any size
- Applicable on any piping design
- Not affected by pre-existing hydrocarbons in soil
Testing Steps Overview

- Inject small amount of inert tracer compound into fuel
- Install small vapor sampling probes adjacent to pipelines
- Collect soil vapor samples and analyze for presence of tracer in the soil
- Pinpoint as needed
Tracer Injection

- Inject directly into pipeline or into associated storage tanks
Probe Installation

• Manually install soil vapor monitoring probes vertically adjacent to pipeline
Sample Collection

- Extract soil vapor from each probe location
Analysis

- Gas Chromatography
- On-Site Mobile Laboratory
Leak Location

- Probes of highest concentration show vicinity of leak source
Facility Applications

- Airports
- Military Installations
- Power Plants
- Refineries
- Bulk Storage Terminals
Bulk Storage Terminal Program

• In 2009, teamed with Phillips 66 to assess buried piping integrity at terminals nationwide
Tracer Gas Assessment Program – Facility Piping

• Background & Drivers
• Facilities Risk Management
• Tracer Gas Detection & Assessment Process
• Tracer Gas Program Status
• Results & Lessons Learned
Background & Drivers

- Industry attention on Facilities
  - API PPTS data
  - Regulators interest
  - PRCI Projects
- Why Tracer Gas? – “Drivers”
  - Current Condition information
  - Global/ On-line/ Non-Destructive method
  - Cost/Effective
  - No disruption to system operations

![Releases by Location](chart)

<table>
<thead>
<tr>
<th></th>
<th>FACILITY</th>
<th>ONSHORE PIPELINE</th>
<th>TANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td></td>
<td></td>
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<tr>
<td>2016</td>
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</tbody>
</table>
Background & Drivers

2015 PPTS VS. PHMSA INCIDENTS BY CAUSE
(NORMALIZED BY MILES)
Risk Assessment Tool

- Establish a Risk Assessment Procedure
- Use of Corporate Risk Matrix
- Establish Consequences of Failure
  - HCAs
  - Business Impact
- Establish likelihoods of Failure
  - External Corrosion
  - Internal Corrosion
Facility Risk Management

- Profile Radiography
- GWUT (Guided-Wave)
- Phased Array
- Long or Short Wave UT
- EMAT
- ILI – MFL / UT Tools
- NDE Robots / Crawlers
- Tracer Gas Leak Detection
- P/S Potential Surveys
- ACVG / DCVG
Tracer Gas Assessment & Detection Process

Pre-Work in Year Prior to Execution

- Select Facility Based on Established Criteria
- Review Schedule with TGT Contractor and Maint Integrity Coord (Develop Budget Estimate)
- Conduct On-site Logistic Coordination Review with Facilities
- Establish Preliminary Target Dates and Notify Facilities
- Develop Detailed Proposal and Work Plan
- Document Decisions and Actions on Pre-Plan

Execution

- Confirm Schedule with Facilities
- Initiate Management of Change
- Establish Target Probe Install and Inoculation Dates
- Install Probes per Pre-Plan
- Inoculate per Pre-Plan
- Collect and Analyze Samples

Report and Reschedule

- Contractor to Notify Main Integrity Coord of Test Status
- If Not OK, Delineate Anomaly (Detection)
- If Leak Confirmed, Facility will Initiate Repair Process
- After Repair Completed, Resume TGT

- If Anomaly (Detection) Confirmed, Document and Resume TGT

- If Ok, Main Integrity Coord to Notify Site and Facility Integrity Group
- TGT Contractor to Forward Final Documentation to Facility and Facility Integrity Group Within 30 Days

- Schedule Next Test Based on Results
Tracer Gas Program Evolution & Status

1. Facilities Risk Rank initially based on HCAs (Consequences)
2. Multi-annual First Pass based on Risk
3. Initial re-test frequency 5 years
4. Additional assessments to define re-test frequency
5. Tracer Gas Assessments as an input for Risk Assessment Model (Likelihood of failure component)

Baseline Test Scope / Status:
• 51 Facilities Tested
# Tracer Gas Re-Test Frequency

<table>
<thead>
<tr>
<th>Service</th>
<th>Maximum Tracer Gas Testing Frequency (years)*</th>
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<tbody>
<tr>
<td></td>
<td>Low Consequence Area-no leak history**</td>
</tr>
<tr>
<td>Refined Product</td>
<td>10</td>
</tr>
<tr>
<td>Crude</td>
<td>7</td>
</tr>
<tr>
<td>Ethanol (PWHT)</td>
<td>10</td>
</tr>
<tr>
<td>Ethanol (NO PWHT)</td>
<td>7</td>
</tr>
<tr>
<td>Drains/Process Water</td>
<td>7</td>
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</tbody>
</table>

* Frequency is the maximum recommended frequency between testing. Specific applications may require a shorter frequency as determined on a case by case basis by the Integrity Group and Division Technical Representatives.

** Leak history = corrosion related leak within the last 5 years. This includes any corrosion related leak on buried piping and only internal related for above ground piping with the exception of soil to air interfaces.
Results and Lessons Learned

- “Positives” detected at 6 of 48 facilities tested
- “Positives” Type/Cause
  - 1 dead leg
  - 1 ethanol flange pair
  - 1 water draw
  - 3 drain systems

1. Structure validation process for positives
2. Tracer gas is very accurate for detection (Sensitivity)
3. Main cause of failure on buried piping is internal corrosion
4. Opportunities
   - Tracer Gas detection on dead legs
   - Failure cause analysis and trending