Pipeline Research Council International, Inc.

DOE Natural Gas Infrastructure R&D and Methane Emissions Mitigation Workshop

- Industry Research for Pipeline Systems Panel

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Pipeline Research Council Int’l. Overview

- Founded in 1952 – Current Membership
  - 39 Pipelines, over 350,000 miles of transmission pipe
    - Natural Gas and Hazardous Liquids Pipelines
    - 27 members are North American based
      - Remainder: Europe, Brazil, China, Saudi Arabia, South Africa
  - Energy Industry Associations: AOPL, OTD, EPRI
  - 39 Technical Program Associate Members
    - Key equipment and service providers to pipelines. Pipe mills, ILI vendors, Integrity mgmt service co’s, Compressor engine mfr’s

- Funding
  - Annual subscription based on pipeline mileage
    - 2014 R&D program size: ~$ 10 Million
PRCI Research Program Structure

- **R&D Program Development Process**
  - Determined annually via a menu of potential projects provided by the six Technical Committees
    - Project ideas identified in winter/spring
    - PRCI Board votes over the summer – finalizes in September

- **Technical Committees comprised of member reps**
  - Identify, screen & propose potential research projects
  - Project teams select contractors & approve workscopes, provide general project oversight, provide peer review of results, and approve results on behalf of PRCI
PRCI Technical Committees

- Operations & Integrity
- Design, Materials & Construction
- Corrosion
- Compressor & Pump Station
- Measurement
- Underground Storage
## 2012 EPA GHG Inventory – Gas T&S

<table>
<thead>
<tr>
<th>Activity</th>
<th>Methane Emissions (Mg)</th>
<th>Percentage of Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reciprocating Compressors</td>
<td>773,000</td>
<td>31.4%</td>
</tr>
<tr>
<td>Centrifugal Compressors (Wet Seals)</td>
<td>232,000</td>
<td>9.5%</td>
</tr>
<tr>
<td>Compressor Engine Exhaust</td>
<td>235,000</td>
<td>9.5%</td>
</tr>
<tr>
<td>Pneumatic Devices</td>
<td>221,000</td>
<td>9%</td>
</tr>
<tr>
<td>Pipeline Venting (O&amp;M)</td>
<td>184,000</td>
<td>7.5%</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>1,645,000</strong></td>
<td><strong>66.9%</strong></td>
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PRCI Methane-Related program objectives

- **Keep the product in the line!!**
  - Robust Pipeline Integrity Program
  - 80% of current budgets

- **Avoid blowdowns**
  - Better integrity management practice and inspection technology improvements to improve understanding of exact pipe condition – avoid cutouts
  - Inspection methods for unpiggable lines

- **Detect any product releases as soon as possible**
  - Maximize safety along pipeline right-of-way
  - Minimize environmental impacts
PRCI Methane-Related program objectives

- Continually improve practice to minimize gas releases
  - Welding Practices & Weld Inspection
    - Optimize hot tap welding on new steels to avoid blowdowns
  - Pipeline Repair Technology & Procedures
    - Enable composite repairs & sleeves vs. cutouts and blowdowns
    - Installation practices & Long-term performance
  - Assess the Structural Significance of Defects
    - Avoid blowdowns due to unnecessarily conservative repair practices
PRCI Methane-Related program objectives

- Enable compressor station operators to comply with EPA GHG reporting at least cost
  - Identify leak sources & remediation options
  - Develop emissions factors that are statistically valid to enable resources to be directed to remediation vs. simply measurement

- Underground Storage Committee
  - Storage Field Integrity Program
    - Minimize casing leaks, optimize ILI effectiveness
PRCI Sample Repository
(Technology Development Center in 2015)

- Established a facility in Houston that provides storage and working areas for full scale pipe samples.
- Currently ~700 pipeline damage samples – unique in the world
- A safe, accessible, working environment to enable independent trial, development and performance testing of NDE concepts
- Maintain custody & confidentiality key samples to ensure accuracy
- Reference standards, baseline samples & real-world samples
30,000 sq.ft. building with 20,000 sq. ft. workshop area and ~10,000 sq. ft. of offices and meeting space

Target opening date: May, 2015
PHMSA - ILI Enhancements Project

- Development of Industry test facility and Qualification Processes for ILI Technology Evaluation & Enhancements
- Build Pull Test Rig – Develop ILI Verification Process (not develop an ILI tool specification)
- Use of Samples with known defects
- Conduct ILI tool runs with ILI vendor participation
- Responsive to NTSB Recommendation to assess ILI performance
Erosion and slumping images along a coastal highway generated from radar interferometric measurements from space that are processed through a sophisticated algorithm.
Local Monitoring – Ground Movement

Ground Based Synthetic Aperture Radar Monitoring of Slope Stability along Pipeline ROW
ROW: Right-of-Way Automated Monitoring

- **ROW-3A, 3B & 3C**: Supplemental Testing of Full System Technology Packages for Automated Monitoring of Machinery Threats
  - Prototype Package (Integrated Hardware & Software Package) threat detection validation flights underway [Univ. of Dayton & AAAI]
  - Leak Detection (hyperspectral/IR) sensors to be integrated for validation 2015
  - Leak Detection sensor selection building upon Vapor Plume Modeling (ROW-3E) work from 2013/2014
  - Current fixed wing package also suitable for long-range UAV platform
ROW Research: Addressing Gaps

Gap between CRDS and traditional tools – main issues are time to identify and reach the leak

1,000x Higher Sensitive allows detection at greater distances
ROW-3H: Technology Development

NASA JPL Methane Detector Technology

Miniature sensor for sniffing methane on Mars

Mars version is more sensitive:
- 1 ppb in 1 sec
- Isotopes in methane

Specifications (Earth version)
- 250 g (hand carried)
- 20 ppb 1 sec
- Measures CH₄ + water
- Open-path (quick response)
ROW-3H: Miniature Methane Detection

**Open-path Laser Spectrometer (OPLS)**

Current validation for Hand-carry device to locate/verify methane hot spots.

Operational Prototype ready for industrialization by the end of 2014

2015 Validation using UAV Platform

Mounted on quadrotor
ROW-3K: Long Range UAS on a Pipeline Corridor in the National Airspace System

Objectives:
1) Demonstrate operation of a long range/endurance UAS carrying the RAM Technology Package (ROW-3A/B/C) on a pipeline corridor in civilian airspace – safely, effectively and in full compliance with all FAA and FCC regulations
2) Evaluate the performance differences between manned & unmanned aircraft
3) Establish a test range for continuing research

Benefits:
• Increased safety (eliminate risk to pilots)
• Far greater endurance
• Higher precision flight profiles
• Smaller signature
• Emergency Response
ROW-3K: Long Range UAS

- **Project Timeline:**
  - COA Application submitted with Virginia Center of Excellence
  - Projected Initial flights to begin October 2014

RS-16 UAS™

- 12' Wingspan, 25 lb. payload capacity

Mobile Operations Centers

Multi-Mission Payload System
- Machinery Threat
- Gas Leak
- Liquid Leak
- Encroachment
- Emergency Mgmt

Runway not required for launch or landing operations

Flies for 12+ hours on 1.5 gallons of gasoline
Compressor Station Focus

- PRCI has historically focused on engines/drivers
- Gas Machinery Research Council has historically focused on gas compressors
- Good history of collaboration
- PRCI compressor-oriented work is on characterization, not technology development
- PRCI engine-oriented work primarily for criteria pollutant reduction (NOx, CO, Air Toxics)
  - Methane reduction a virtuous by-product, as improved combustion reduces misfires, which are a major source engine exhaust methane emissions
Objectives: Review eGGRT-GHG reported data for natural gas transmission and storage to:

- Identify data outliers and gather additional data on the root cause of fugitive emissions
- Conduct data analysis to develop additional emission factors to simplify future data reporting. Statistical validity from large data set
  - 3 years of Subpart W data sets to work with
- Free up resources to move from accounting towards remediation and prevention
  - Let’s be honest – resources are not unlimited
Develop/Update GHG Fugitive Emission Factors for Gas Transmission and Storage

- **Objectives:**
  - Improve 15 year-old GHG emission factors, which may enable operators to avoid or reduce the frequency of direct fugitive emissions measurements at affected facilities

- **Some final results are available to members only:**
  - Acoustic Leak Detection Device Performance Review
  - Characterization of Natural Gas Pneumatic Device Types and Review of EPA Default Pneumatic Device Controller Vent Rates

- **Nomenclature for Natural Gas Transmission and Storage Greenhouse Gas Emissions is publicly available**
Methods to Reduce the Carbon Footprint of Pipeline Stations

- **Objective**
  - Catalogue the opportunities to reduce carbon emissions at compressor stations
  - Thermal efficiency (CO2)
  - Fugitive methane (CH4)

- **Final result is publicly available:**
  - www.prci.org
  - “Methods to Reduce the Greenhouse Gas Footprint from Pipeline Compressor and Pump Stations”
  - http://prci.org/index.php/pm/pubs_loca_ldetails/?doci d=869
Greenhouse Gas Roadmap Development

- Plan to develop an overall PRCI GHG roadmap
  - Currently each technical committee is working independently
  - Compressor & Pump Committee farthest along, but the reduction to pipeline integrity impacts (e.g., pipe repairs w/o blowdown) is not well captured

- Any resultant projects will be coordinated with larger pipeline industry initiatives to EPA/DOE
Thank you. Questions?

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