Panel 2: Current Industry Research

- PRCI R&D Program

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PHMSA R&D Forum
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Pipeline Research Council Int’l. Overview

- **Membership**
  - 39 Pipelines, over 350,000 miles of transmission pipe
    - Natural Gas and Hazardous Liquids Pipelines
    - Membership generally at the Pipeline holding company level
    - 27 members are North American based
      - Remainder: Europe, Brazil, China, Saudi Arabia, South Africa
  - Energy Industry Associations: AOPL, OTD, EPRI
  - 37 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: $ 9.6 Million
PRCI Research Program Structure

- **R&D Program Content**
  - Determined annually via a research “ballot” that is a menu of funding requests for specific projects and programs from 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
Pipeline Technical Committees

- **Operations & Integrity ($5.4 MM)**
  - NDE Technology Development & Inspection Methods
  - ROW Protection & Monitoring, Leak Detection
  - System Integrity Management (ERW & Long-Seam)
  - Control Room Operations & Human Factors

- **Design, Materials & Construction Committee ($1.5 MM)**
  - Materials & Metallurgy (line pipe materials, fracture mechanics)
  - Welding Practices & Weld Inspection
  - Design & Construction (loadings, geo-hazards, offshore)
  - Pipeline Repair Technology & Procedures

- **Corrosion Committee ($900K)**
  - Detection, Assessment & Management of Galvanic Corrosion & SCC
  - Improvement of Cathodic Protection Design & Operations
  - Quantitative Risk Assessment – Structural Significance of Defects

81% of 2014 $
Facilities Technical Committees

- **Compressor & Pump Station ($ 950K)**
  - Reciprocating Engine Emissions Compliance
  - Greenhouse Gas Emissions Reporting & Mitigation
  - Engine Reliability & Condition Monitoring

- **Measurement ($ 750K)**
  - Ultrasonic Meter Installation, Diagnostics & Recalibration
  - Adapting Measurement Practices for Shale Gases
  - Expand the Operating Range of Meters
  - Generally Improve Custody Transfer Accuracy

- **Underground Storage ($ 200K)**
  - Storage Field Integrity – ILI tool performance
  - Brine string integrity (salt cavern storage)

19% of 2014 $
2015 R&D Ballot – Open for Voting

- 117 Projects Identified
  - 11 Research Programs plus 79 individual projects
  - $20.6 MM of funding requested
  - $7.9 MM requested in Programs
    - $6.1 MM of which are in Pipeline Integrity Programs

- Continues the long tradition of more needs, wants and ideas than money

- Annually ~70 to 80 projects are funded
  - 80% of these are Pipeline Integrity-related
O&I Committee Overview

- **NDE & Inspection**
  - ILI in the Pipe
    - NDE-1 (girth welds)
    - **NDE-4 ILI Improvements**
  - In Ditch NDE Tools – NDE-2
  - Pipe Sample Defect Characterization – NDE-2
  - Tools for Difficult to Inspect PL’s – NDE-3

- **Damage Prevention & ROW Monitoring**
  - RAM Program – ROW-3 & ROW-6
  - Human Factors – DP-3
O&I Committee Overview

- Leak Detection – PL-1
- ERW & Long-Seam Pipe – IM-3
- Detect & Discriminate Mechanical Damage – MD-1
- Structural Significance of Mechanical Damage – MD-4
- Subsea Pipelines – SPIM-1 & SPIM-3
Pattern recognition for MFL data – a change is noted as pipe properties change

What is the nature of the discrepancy? Diff’t MFL sensors give different responses

Pipe properties?

Yield Strength?

Figure 1: Raw data recorded by a Magnetic Flux Leakage (MFL) in-line inspection (ILI) tool run in three joints of an operating pipeline.
Machinery Threat Detection on ROW

- PRCI Right of Way (RAM) Program – machinery threat detection and leak detection and reporting during routine pipeline aerial patrol
- Present focus is fixed wing aircraft, though drones are likely long-term option

**RAM CONOPS Approach:**

- **Detect** – sensing & imagery collection
- **Process** - data analysis via algorithms
- **Distribute** – communication
- **Archive** – improved data management processes and predictive modeling

Fixed wing now – future view to UAVs & Satellite

**Pipeline Ops Center**

Confirm and Respond to Threat
Satellite Monitoring – Ground Movement

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
NDE-3: “Difficult to Inspect” Segments

- Project to assess Large Standoff Magnetometry (LSM)

- LSM devices offer the promise of assessing pipeline condition from above ground, through significant cover

- The market has a number of techniques using similar base principles known by their acronyms:
  - MTM – Magnetic Tomography Method - Transkor
  - MMM – Magnetic Memory Method - Energydiagnostika
  - SCT – Stress Concentration Technique - Speir Hunter

- Virtually all the data rests with the technology providers – little to no independent verification or documented use of these tools.
Test Bed to Evaluate External NDE Tools

Earthen berm

20-inch NPS pipe

Shoring to support berm

36 inches
Corrosion TC – Active Programs

External Corrosion

*EC-1 Reliability-Based Integrity Management Program

EC-2 Structural Significance of Corrosion Defects

EC-3 Coatings Performance and Effectiveness

EC-8 Cathodic Protection System Performance

Stress Corrosion Cracking

SCC-1 Site Identification and Re-Inspection Intervals for SCC DA

SCC-2 SCC Susceptibility Evaluations

SCC-5 SCC Mitigation and Repair

Internal Corrosion

IC-1 Internal Corrosion Threat Assessment

Active Projects Count

- IC
- SCC
- EC
DMC Emphasis Areas with Focus

Design and Assessment
- Improved basis-of-design
- Subsea pipelines
- Evaluation of external loading
- CO2 pipelines and equipment

Strain Based Design and Assessment
- Design for new pipelines
- Assessment of existing pipelines

Materials
- Improved pipe materials – properties and quality
- Corrosion resistant alloys
- High strength steels
- High performance materials
DMC Emphasis Areas with Focus

**Welding**
- Codes, standards, testing
- Improved properties, productivity and quality
- Weld procedures/ In-service welding

**Construction**
- Improved construction productivity and quality
- Inspection
- Route selection

**Assessment and Repair**
- Damage assessment
- Repair methods - sleeves, composites, etc.

**Fracture**
- Fracture initiation, propagation and arrest
- Assessment of weld flaws
PHMSA - ILI Enhancements Project

- PHMSA R&D project award – September, 2013
- 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 – but continue to gather and characterize add’l features
- Conduct ILI tool runs with ILI vendor participation
- Responsive to NTSB Recommendation to assess ILI performance
## Key Components of the ILI Test Program

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<td>Samples</td>
<td>Availability of samples with real flaws and a wide range of morphologies.</td>
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<td>Calibration/Base-lining</td>
<td>Have a fixed reference point or benchmark – what are we comparing performance to.</td>
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<td>Testing &amp; Proctoring</td>
<td>Test a range of tools, types, procedures and the influence of human factors.</td>
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<td>Analysis &amp; Publication</td>
<td>Establish what the data is telling us and get the data out to the industry – make use of the R&amp;D.</td>
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<td>Legacy</td>
<td>Retain the benchmarks for improvement – provide for education, development and measuring, i.e., are we improving?</td>
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Established a facility in Houston that provides storage and working areas for full scale pipe samples.

Currently ~660 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
Additional Inspection Capability

- Pigging Loops installed in 2013
  - 18 inch and 10 inch Loops transferred from Subsea Integrity Group (UK)
  - Initially hosted dry crawler tests
  - Known defect inserts can be fitted into the loops to test ILI equipment.
PRCI Technology Development Center

Major Commitment by PRCI
July 2014
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: February, 2015
Langfield Road

8 acres including 600” pull test rig, and 5 acres pipe storage and crawler loops
Thank you. Questions?

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