Pipeline Research Council International, Inc.

PRCI Natural Gas Pipeline Integrity Research

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Pipeline Research Council Int’l. Overview

- **Membership**
  - 38 Pipelines, over 350,000 miles of transmission pipe
    - Natural Gas and Hazardous Liquids Pipelines
    - Membership generally at the Pipeline holding company level
    - 28 members are North American based
    - Remainder: Europe, Brazil, China, Saudi Arabia, South Africa
  - Energy Industry Associations: AOPL, OTD, EPRI
  - 37 Associate and 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
    - 2015 R&D program size: $ 10.2 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, frame & screen 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 ($5.7 MM)**
  - NDE Technology Development & Inspection Methods
  - ROW Protection & Monitoring, Leak Detection
  - System Integrity Management (ERW & Long-Seam Weld Inspection)
  - Control Room Operations & Human Factors

- **Design, Materials & Construction Committee ($1.6 MM)**
  - Materials & Metallurgy (line pipe materials, fracture mechanics)
  - Welding Practices & Weld Inspection
  - Design & Construction (loadings, geo-hazards, offshore)
  - Pipeline Repair Technology & Procedures

- **Corrosion Committee ($660K)**
  - Detection, Assessment & Management of Galvanic Corrosion & SCC
  - Improvement of Cathodic Protection Design & Operations
  - Quantitative Risk Assessment – Structural Significance of Defects
Facilities Technical Committees

- **Compressor & Pump Station ($ 1.22MM)**
  - Reciprocating Engine Emissions Compliance
  - Greenhouse Gas Emissions Reporting & Mitigation
  - Engine Reliability & Condition Monitoring

- **Measurement ($ 850K)**
  - Ultrasonic Meter Installation, Diagnostics & Recalibration
  - Adapting Measurement Practices for Shale Gases
  - Expand the Operating Range of Meters, and generally Improve Custody Transfer Accuracy

- **Underground Storage ($ 240K)**
  - Storage Field Integrity – ILI downhole tool performance
  - Brine string integrity (salt cavern storage)
In-Line Inspection (within the pipe)
- Assess & refine the performance of various existing and emerging ILI technologies for specific purposes

Girth welds, offshore-risers, integrated cleaning & monitoring tool (NDE-1)

Determine pipe properties (NDE-4A)

In-situ mechanical property measurements for low-toughness, vintage pipe (NDE-4C)

Crack tool reliability & performance evaluation (NDE-4E)
PHMSA - ILI Enhancements Project

- PHMSA R&D project award – September, 2013 (NDE-4F)
- 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 – will continue to gather and characterize additional pipe defect sets
- Conduct ILI tool runs with ILI vendor participation
- Responsive to NTSB Recommendation to assess ILI performance vs. specs
ILI Pull Test Rig - Status

- Commissioned two test strings & demonstrated winch operation
  - PHMSA project has a focus on metal loss and mechanical damage
  - Pipe strings: 24” & 16” diameters, 500’ & 350’ long, characterized defects
  - Custom built winch can pull over 5,000 lbs at a speed of 10 feet/sec
“Difficult to Inspect” Pipelines (NDE-3)

- **Assess Large Standoff Magnetometry (LSM) Concepts**
  - These offer the promise of assessing pipeline condition from above ground, through significant cover

- **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

- Previously, little to no independent verification or technically documented use of these tools.
Test Bed to Evaluate External NDE Tools

Earthen berm

20-inch NPS pipe

Shoring to support berm

36 inches
ERW and Longitudinal Seam Welds

- Provide operators with a comprehensive framework and guidance for integrity management of longitudinal seam welded pipe.

- Evaluation of ILI Technologies to Characterize Long Seam Features (IM-3B)

- Qualification of NDE Methods for In-ditch Analysis of ERW Pipe Weld Seam Anomalies (IM-3C)
  - Round robin tests of NDE tools using ERW samples
  - Development of standardized NDE protocols for in-ditch NDE of ERW seam features
Industry guidance document in development to apply hydrostatic test guidelines to all pipe types (AOPL/INGAA). PRCI work (IM-3E) is specific to ERW seam weld integrity

- Understand threshold where pipe damage may occur due to hydrotesting – is 110% of SMYS damaging??
- Target completion is September, 2015

Develop a comprehensive guidelines for integrity management for Operators once hydrotest guidelines are completed (IM-3F)
Pipeline Right-of-Way Management

- Improved methods to monitor the pipeline right-of-way for 3rd party threats, gas leaks, land movement and general encroachment
  - Utilize advanced sensor technologies on a variety of platforms – ground patrols, aircraft, drones & satellites

- Testing of Full System Technology Packages for Automated Monitoring of Machinery Threats & Algorithm Development for Machinery Threat Detection (ROW-3A & 3C)
  - Conventional aircraft, with advanced sensors & data processing. Greatly speed data interpretation & accuracy

- Methane detection system sensor to for use by on-foot leak surveyors and potentially small UAVs (ROW-3H)
  - Using JPL (Mars Rover) technology. PG&E is champion.
Pipeline Right-of-Way Management

- Demonstrate & Evaluate the operation of long endurance (12-16 hour) UAS to conduct pipeline patrols (ROW-3K)
  - FAA-sanctioned flights
  - Initial test flights held March & June, 2015 on Colonial Pipeline ROW in Virginia
  - Enables greater frequency of ROW monitoring with improved sensors/interpretation
  - Unmanned – thus reduced pilot risk, as well.
Satellite Monitoring (ROW-6)

- PRCI Satellite Technology Evaluation for ROW encroachment – accessing an expanded satellite network
  - Optical and SAR (RADARSAT-1)
  - Prior results show 80%+ detection with less than 15% false call
  - Reports in 3.5 hours

Using more than one satellite to increase revisit frequency, it is possible to see the same spot on earth 4-8 times a day.

Generally oriented north-south
Broad Area Surface Change Detection

- Detect, map and monitor ground surface change over vast areas without ground control
- Provide status of surface conditions during and after adverse weather episodes
- Three methods used for change detection:
  - InSAR, ground movement
  - Polarimetry, ground cover change
  - Amplitude, land use change
- Risk Index Map developed
Broad Area Surface Change Detection

- Study area highly prone to landslides, erosion and wildfires
Ground Subsidence

- Develop technique to measure north-south horizontal ground movement
- Correlate historical ground movement measurements to past pipeline incidents
Corrosion – Active Projects

**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

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

**SCC-2** SCC Susceptibility Evaluations

**SCC-5** SCC Mitigation and Repair

**IC-1** Internal Corrosion Threat Assessment

![Active Projects Count](chart.png)
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
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
PRCI TDC External Rendering

- 30,000 sq.ft. building with 20,000 sq. ft. workshop area and ~10,000 sq. ft. of offices and meeting space
- 8 acres of land for pull tests & loops
- Opened May 2015
Thank you. Questions?

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