



LEADING PIPELINE RESEARCH



PHMSA Workshop
Cased Pipeline Integrity Management

CHICAGO, IL • JULY 15, 2008

RESEARCH EFFORTS FOR ADDRESSING CASED PIPELINE INTEGRITY MANAGEMENT



PRCI Research Programs Review

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PRCI

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PRCI Membership Drives Research

- **39 Energy Pipeline Operating Companies**
 - *26 Natural Gas Transmission; 11 Liquid*
 - *2 Liquid/Natural Gas*
- **World-wide Research Organization**
 - *27 U.S. Companies*
 - *12 Non-U.S. (Brazil, Canada, Europe, Saudi Arabia)*
- **14 Associate Members**
 - *U.S.; Canada; Mexico; Japan*



LEADING PIPELINE RESEARCH WORLDWIDE



Alliance Pipeline Limited
Enbridge Pipelines, Inc.
IPSCO
TransCanada Pipelines, Ltd
TransGas, Ltd

Tuberia Laguna
Tubos de Acero de Mexico

Petrobras

Applus RTD
Association of Oil Pipelines (AOPL)
Berg Steel Pipe Corp.
BJ Pipeline Inspection Services
Boardwalk Pipelines
BP
Buckeye Partners, LP
CenterPoint Energy Gas Transmission
Chevron Pipe Line Company
Colonial Pipeline Company
Colorado Interstate Gas
Columbia Gas Transmission Corp.
ConocoPhillips Pipe Line Company
Dominion Transmission Corp.
El Paso Natural Gas
EPCO, Inc.
Explorer Pipeline Company
ExxonMobil Pipeline Company
GE Oil & Gas
Lincoln Electric Company
Marathon Pipe Line LLC
National Fuel Gas Supply Corporation
Nippon Steel (Japan)
ONEOK Partners
Pacific Gas & Electric Co.
Panhandle Energy Company
Rosen
Shell Pipeline Company LP
Siemens Energy & Automation, Inc.
Solar Turbines
Southern California Gas Co.
Southern Natural Gas
Spectra Energy Transmission, LLC
T.D. Williamson, Inc.
Tennessee Gas Pipeline
Transwestern Pipeline Co.
Tuboscope Pipeline Services
Williams Gas Pipeline



Gassco A.S.

Gasum Oy

National Grid

N.V. Nederlandse Gasunie

Gaz de France

Total S.A.

Saudi Aramco



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PRCI Research Implementation

- **Six Technical Committees in Two Distinct Research Programs**
 - Three each in Pipelines & Facilities; all focus on integrity & reliability
 - Develop and maintain roadmaps of our research objectives
 - Inspection
 - Assessment
 - Prevention & Mitigation
 - Identify, review, and approve relevant research projects and programs
- **Research Project Development**
 - Annual process - ballot and project funding
 - Approximately \$10-13 MM annual funding commitments
- **Collaboration with other Organizations**



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Research Related to Cased Pipelines

- **Past research limited**
 - **Field Techniques to Determine Electrical Shorts Between Carrier Pipe and Casing (1988)**
 - **Method for Assessing Electrical Resistance of Pipeline Casing (1989)**
 - **Investigation of Cased-Carrier Pipe External Corrosion (1991)**
 - **Cofunding for a portion of the NYSEARCH TIGRE project**
 - **Supported projects on GWUT and cased pipeline integrity through GTI/GRI**
- **Many members have test leads or lines are piggable**



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Research Related to Cased Pipelines

■ Current Program Areas

- External Corrosion – 2 active projects
- NDE – 1 active project; 2 others included on PRCI 2009 ballot
 - Effective tools and methodologies for locating and characterizing corrosion in difficult to inspect areas including cased crossings, water crossings, pavements, and hard surfaces
 - Platforms and sensor technology for in-line inspection of unpiggable pipelines
 - Validated guidelines for conducting direct assessments and CDA for corrosion



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Current PRCI Research Projects

Direct Examination Techniques for Shorted and Non-shortened Cased Crossings

- **Understand and evaluate techniques that can detect the presence and type of shorts**
 - The presence of a metallic short is a significant factor for corrosion
 - Shorted casings are **four times** more susceptible than non-shortened (INGAA report)
 - Standard, non-standard, and new methods exist to identify shorted conditions
- **Apply a Corrosion Threat Assessment and Prioritization; example below**
 - Metallic short – immediate inspection (severe)
 - Electrolyte short – scheduled inspection (moderate)
 - Intermittent – monitor (minor)
 - clear – no action
- **Consider other influences in project**
 - Seasonal and atmospheric
 - Corrosion by CP shielding and CP on bare piping

Current PRCI Research Projects

Direct Examination Techniques for Shorted and Non-shortened Cased Crossings (cont.)

- **Focus on aboveground techniques, without the need of test facilities**
 - **Two existing techniques not addressed by NACE Standard RP 0200**
 - ACCA, or Pipeline Corrosion Mapping (PCM)
 - ACVG, or PCM A-Frame
 - **Belowground techniques, requiring the existence of test facilities**
 - NACE RP 2000 - On-Off Potential, Annulus Resistance (0.01 ohm), Forced Depolarization, Potential Profile
 - **Other techniques**
 - Electrochemical Impedance Spectroscopy
 - Time Domain Reflectometry
- ← Differentiate short type

Current PRCI Research Projects

Direct Examination Techniques for Shorted and Non-shorter Cased Crossings (cont.)

- **Data reviewed for 153 cased segments for ACCA, ACVG, and CIS**
 - *Only ~7 % show indications of metallic short*
 - *~59% show indications of electrolytic shorts*
- **14 excavations (7 cased pipes) performed of the casings with suspected shorts; data under review**
- **Evaluate the probability of success of each technique**
- **Compare short status with extent/severity of external corrosion on carrier pipe**
- **Apply results to prioritization procedure**
- **Validate with other field data**

Current PRCI Research Projects

Direct Examination Techniques for Shorted and Non-shorter Cased Crossings (cont.)

- **Aboveground Techniques (PCM, A-Frame) - Limitations**
 - Not useful for detecting atmospheric corrosion
 - Limited data sets available for validating the effectiveness of the techniques
- **Additional data to be collected/sought for validation**
 - Participation by non-PRCI members welcome
 - Continue validation of the effectiveness of these techniques using DA data
- **Develop comprehensive risk assessment methodology**
 - Short is one corrosion cause; other causes need to be addressed
 - A comprehensive ranking methodology needs to be developed

Current PRCI Research Projects

Above ground surveys for Difficult to Assess Areas

Project not yet underway; RFP being developed

- Compliment to shorted/non-shortened cased pipe project
- Determine above ground techniques for performing integrity assessments on difficult to inspect locations
 - cross over piping
 - deep piping
 - dead legs, taps, earthen water crossings, bridles, mechanically coupled pipe, congested areas, parallel pipe, overhead cased crossings, etc.
- Provide a critical review and improved understanding of existing tools – interpretation/accuracy and limitations

Current PRCI Research Projects

Above ground surveys for Difficult to Assess Areas (cont.)

- Identify alternative techniques to the conventional above ground surveys in difficult to assess areas
 - New or enhanced above ground or other CP survey techniques
 - Alternatives to hydrotest and 100% examination
 - Include POD & sizing accuracy
- Develop a matrix of categories vs. applicable technology
- Evaluate the preferred technology for relevant categories
- Develop a best practice guideline for each category
- Develop decision tree of sound engineering practices that might be applied to assess pipe in difficult areas [e.g., similar service]



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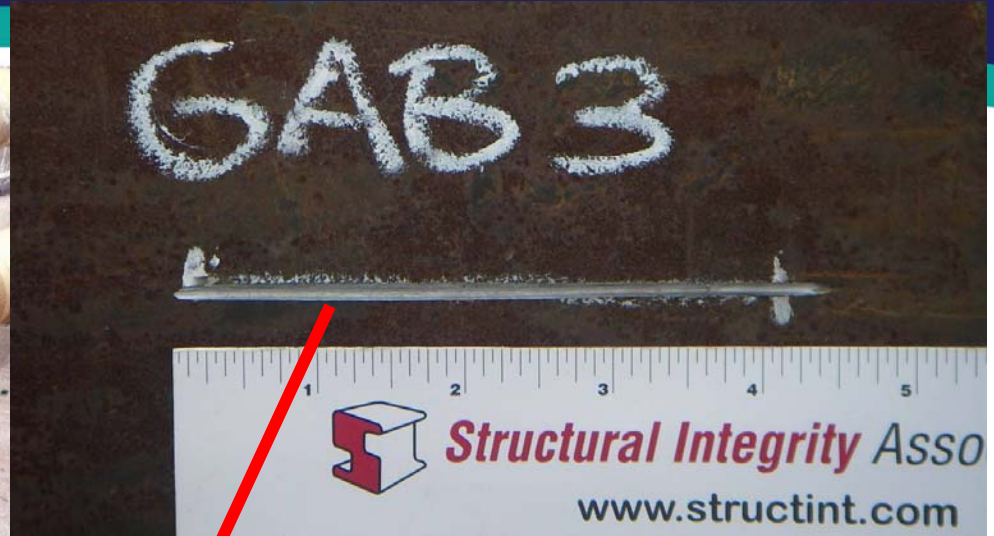
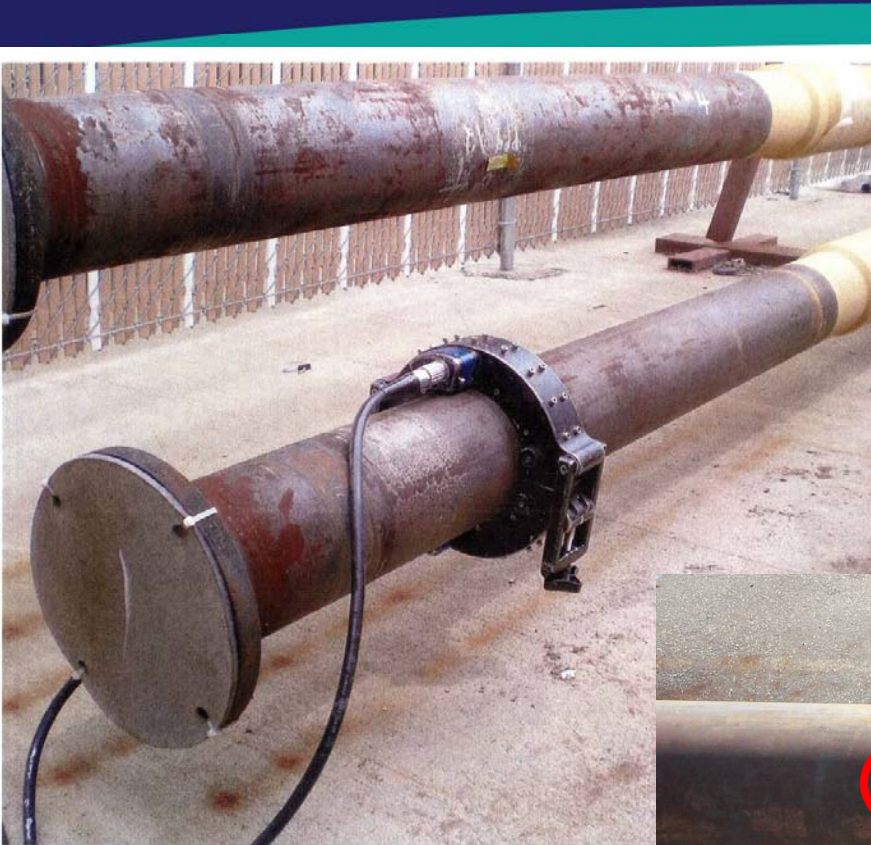


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Current PRCI Research Projects

Defining the Ability of New (Third) Generation Guided Ultrasonics Systems to Assess Narrow, Axial Anomalies

- Performance evaluation of GWUT; sizing and detection of axially oriented flaws (length is key)
- Bare pipe and Neoprene Coated pipe
- Improved classification and prioritization
- Failure pressure influenced by BOTH depth AND length
- Accurate length estimates improve ability to prioritize features



Test samples

Current PRCI Research Projects

Defining the Ability of New (Third) Generation Guided Ultrasonics Systems to Assess Narrow, Axial Anomalies

■ Bare Pipe Results

- 2 equal sets of machined defects – narrow, axial; same width across both sets, each set had same depth & width with varying length
- Testing on above ground sections before and after defect fabrication
- Achievable detection at <math><0.2\%</math> CSA; order of magnitude better than typical for buried or coated pipe (2-8%)
- Flaw sizing error varied

■ Neoprene Coated Pipe

- Coating dampens the wave transmission; no useful data obtained (8-channel)
- Subsequent analysis using 16-channel transducer produced much better results



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Proposed PRCI Research Projects

Recommended practice for use of Guided Wave to inspect above-ground and non-piggable pipelines

- **Guidelines for the qualification and use of Guided Wave inspections systems used in gas and liquids pipelines**
- **A Recommended Practice document providing:**
 - A clear description of the inspection capabilities of Guided Wave
 - A listing or matrix illustrating where Guided Wave can be expected to provide reliable inspections results
 - Guidelines to aid Pipeline Operators for understanding inspection results and reporting capabilities and/or limitations of Guided Wave.
 - A recommended format for reporting inspection results.



Proposed PRCI Research Projects

Use of Long Range Guided Wave Ultrasonics for Fitness for Service Determination of Pipelines

- **Provide detailed analysis required to improve the level of performance and reliability needed in application of guided wave inspection data**
 - Utilization of GWUT data to generate the input for application of methods such as B31G or RSTRENG and similar
- **Correlation of signals from GWUT to actual defects**
 - Use database of detailed measurement of corrosion defects/dimensions
 - Establish shape characteristics of defects and categorize
 - Modeling of low frequency long range ultrasonic propagation
- **Analysis via virtual approach – models to run analysis**
- **GWUT sensitivity – largest defect missed is not an integrity issue - length & metal loss**
- **Deliverables are a demonstrated relationship between guided wave responses and flaw severity and a validated practical procedure for data gathering and analysis of pipe integrity using standard procedures**
- **Seeks to build on prior work on axial flaws**

Related PRCI Research

Guideline on Reliability-Based Pipeline Integrity Methods

- **Reflects regulatory shift to quantitative IMP approach**
 - CSA Z662
 - ASME B31.8
 - ISO 16708 (Europe)
- **Comprehensive methodology for assessing pipeline integrity with respect to corrosion over time using reliability-based methods**
 - Formally account for all relevant forms of uncertainty
 - Reflect the impact of maintenance actions
- **Provide an objective and quantitative basis for establishing defect repair sequence and setting re-inspection interval**
- **Demonstrated method for assessing POF – measurement uncertainty and instrument sensitivity are key**

Challenges and Issues for Further Research

- **ECDA has gained acceptance but all cased pipe should not be force-fit into the full ECDA approach**
 - What are the meaningful parameters for casing
 - What data needs to be integrated into “assessment” protocols
- **Assessment does not always = inspection**
 - Tools vs. sound engineering practice
 - New tools/technologies and improved application of existing approaches
- **Improved understanding GWUT - benefits and limitations**
- **Develop simple screening techniques – active vs inactive**
- **Support a risk modeling approach**
- **Post 2012 – future inspections**

Questions?

