An Overview of PRCI’s Research Program

Christina Sames
Pipeline Research Council International, Inc.
API 2004 Pipeline Conference
Today’s Briefing

- Overview of PRCI
- 2003/2004 Focus
- Project Highlights
- Future Focus
Pipeline Research Council International, Inc. (PRCI)

A collaborative technology development organization

Of, By, and For

the energy pipeline industry
Established in 1952 by 15 North American natural gas companies to address long-running brittle fractures.

Not-for-profit corporation since 2000

Current membership:
- 33 national & international pipeline companies
- 300,000 miles of natural gas & hazardous liquid pipelines
- AOPL
- GTI
Who We Are
How Does it Work?

- Pipeline member technical experts plan & manage the technical agenda
- One Member/One-Vote on the Board & Technical Committees
- Members Have Free Access to All PRCI Technology
- More Than $185MM Contributed Since 1952
PRCI Technical Committees

- Corrosion and Inspection
- Design, Construction, and Operations
- Materials
- Measurement
- Underground Storage
- Compressor and Pump Station
## R&D Budgets

<table>
<thead>
<tr>
<th>Program</th>
<th>2003</th>
<th>Co-fund</th>
<th>2004</th>
<th>Co-funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design, Const. &amp; Ops.</td>
<td>$1.6MM</td>
<td>$1.0MM</td>
<td>$2.0MM</td>
<td>$1.5MM</td>
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<tr>
<td>Materials</td>
<td>3.0</td>
<td>0.6</td>
<td>3.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Corrosion &amp; Inspect</td>
<td>3.8</td>
<td>0.5</td>
<td>3.7</td>
<td>3.1</td>
</tr>
<tr>
<td>Compressor &amp; Pump</td>
<td>1.4</td>
<td>1.9</td>
<td>1.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Underground Storage</td>
<td>0.6</td>
<td>0.7</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Measurement</td>
<td>0.7</td>
<td>0.3</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$11.1MM</strong></td>
<td><strong>$5.0MM</strong></td>
<td><strong>$12MM</strong></td>
<td><strong>$9.2MM</strong></td>
</tr>
</tbody>
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2003 total $16.1MM  
2004 total $21.2MM
PRCI Committees

- Corrosion and Inspection
  - ILI for mechanical damage, cracks, & geometry, direct assessment, coatings & inspection tools, SCC, MIC

- Design Construction and Operations
  - Implementing new integrity standards, reliability based design, preventing 3rd party damage, human factors, abnormal external loads, wrinkles/wripples

- Materials
  - Stronger steels, (X100 and beyond), repair & assessment tools, new welding and inspection processes, processes to lower construction costs
PRCI Committees

• Compressor and Pump Stations
  • Flexibility, Life Extension & Reliability, Engine Efficiency and Environmental Compliance
• Measurement and Metering
  • Reliability and Accuracy, Wet Gas Solutions, Product/Pipe Compatibility and Integrity
• Underground Storage
  • Cavern Safety, Productivity, & Deliverability
  • Cavern Expansion
Corrosion and Inspection Programs

7 Programs, ~ $11MM in 2003/04

- Locate Mechanical Damage
- Enhance Integrity of Non-piggable Pipelines
- Protect Shielded Pipe and Enhance Environmental Corrosivity Models
- Identify and Prioritize Locations for Internal Corrosion Inspection, Monitoring, and Mitigation
- Optimize Integrity Assessment Intervals
- Improve SCC detection, assessment and management
- Improve CP System Effectiveness
Corrosion and Inspection Projects

- Locate Mechanical Damage
  - Details of Defect Induces in MFL Signals
    - Total funding: $2.2M
    - Model MFL signal responses to determine stress fields and detect mechanical damage
    - Completion: 2005
Corrosion and Inspection Projects

- Improve CP System Effectiveness
  - Develop Quantitative Relationships Required to Define Mitigation Levels Necessary to Prevent Corrosion
  
  Total funding: $500K

  Model distribution paths of AC in confined corridors and suggest mitigation strategies

  Completion: 2005
Design, Construction, and Operation Programs

7 programs and ~ $6MM in 2003/2004

- Prevention of 3rd party damage
- Implementing integrity standards
- Reliability-based design alternatives
- Determination of maximum safe surface loads
- Leak detection and notification
- Prevention of critical pipeline strains
- Solutions for adverse crossings
Design, Construction, and Operation Programs

- Prevention of 3rd party damage
  - Detection & Monitoring:
    Develop acoustic monitoring for mechanical damage, satellite imagery for unauthorized encroachment and ground movement, and software to detect changes in radar images

Total funding: $1.7M
Completion: 2004
Design, Construction, and Operation Programs

→ Leak Detection and Notification

- Liquid Release Detection:
  Parametric based model to lower the leak detection threshold for liquid pipelines
  Total funding: $400K
  Completion 2005
Design, Construction, and Operation Programs

Prevention of Critical Pipeline Strains

Models and methods for addressing pipe-soil interaction effects in design and mitigation (including frozen soils)
Completion: 2004
Materials Programs

➡️ 4 Programs, ~ $9MM in 2003/04

- Integrity Assessment and Management of in-service damage
- New Materials and Welding Processes to Lower the Cost of New Pipeline Construction
- Maintenance Welding Techniques
- Advanced Material Design, Safety, and Integrity
Materials Projects

- Integrity Assessment and Management for In-Service Damage
  - SCC Crack Extension and Coalescence Modeling: Extend the SCC crack growth model to project SCC behavior over time under generalized loading conditions
  - SCC Avoidance in Ethanol Pipelines: Identify the primary factors and range of service conditions likely to cause SCC in ethanol pipelines
Materials Projects

→ Integrity Assessment and Management for In-Service Damage

– Assessment of Remaining Strength of Corroded Pipe

Guidance to assess remaining strength of corroded pipe subject to biaxial & cyclic loading, of corroded higher strength pipe (x80/100), & failure pressure of corrosion defects in low toughness pipe

Total funding $400K

Completion 2005
Materials Projects

- New Materials and Welding Processes
  - Improved Welding Methods for Pipelines
    Multi-wire GMAW procedures for high speed, high deposition fill pass welding

  Total funding $500K

  Completion 2005
Contact Details

Christina Sames
703/387-0190 X105
csames@PRCI.org

Pipeline Research Council International Inc.
www.prci.org