PRCI Materials Technical Committee - Research on New Materials and Construction Technology

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Joint Pipeline Research and Development Forum

Washington, DC

December 11-12, 2003

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Summary

- Overview of Materials Committee mission, focus and operation
- Review of program areas and goals
- Key current projects in new materials and construction technology
- Issues and research needs for the future

PRCI Committees

- ✓ Corrosion and Inspection
- ✓ Design, Construction, and Operations
- ✓ Materials
- ✓ Measurement
- ✓ Underground Storage
- ✓ Compressor and Pump Stations

Materials Committee Mission

"Improve the performance and integrity of new and existing energy pipelines and lower the costs of pipeline construction, operation and maintenance through research, development and implementation of material, joining and inspection technologies"

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Four major program areas

- 1. Integrity assessment and management of in-service damage
- 2. New materials and welding processes
- 3. Maintenance welding
- 4. Integrity issues in advanced materials design

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Key program drivers

- 1. Reduce frequency, cost and consequences of in-service degradation, improve confidence in integrity
- 2. Reduce construction cost of new pipelines
- 3. Reduce cost, improve safety and reliability of in-service welding
- 4. Address potential integrity issues to enable use of higher strength materials and higher design pressures

Budget and program management cycle

- Major program objectives reviewed on a rolling 5-year basis
- Specific project needs brain-stormed by committee in January, selected and prioritized in May and programs submitted to Board for budget approval in August of each year
- Detailed project proposals reviewed in September, contractors selected, and contracts finalized by January
- Technical management by ad-hoc groups, with milestone reports to full committee

Current budgets ($ millions)

	2003		2004	
	PRCI	Co-fund	PRCI	Co-fund
PRCI total	11.1	5.0	12.0	8.9
Materials	3.0	0.6	3.0	2.5

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Current key projects in Programs 2, 3 and 4

Program 2 New Materials and Welding Processes to Lower the Cost of New Pipeline Construction

- Technical basis for welding higher strength materials
- High productivity welding processes
- Improved detection, sizing and assessment of weld defects
  - Automated inspection
  - Alternative weld assessment standards (ECA)

Program 2 Key 2003-2004 projects

- Welding higher strength materials
  - Optimized consumables for higher strength steels (X80-X100)
  - Tie-in welds in higher strength steels
  - Hydrogen cracking in higher strength weld metals

Program 2 Key 2003-2004 projects

- Higher productivity welding processes

Adaptive control applied to dual tandem GMAW welding for hot/fill/cap passes (50 inches/min)

Program 2 Key 2003-2004 projects

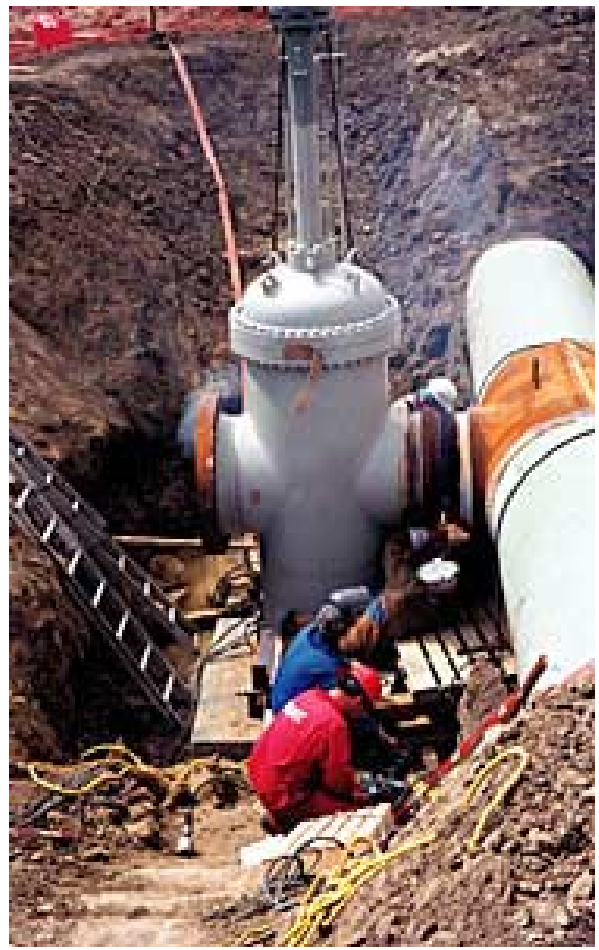
- Improved weld defect detection and assessment methods
  - Automated UT of girth welds and fillet welds
  - Advances in ECA methods, including strain-based design limits

Program 3 Maintenance Welding Techniques to Improve Operations

- Safety during in-service welding
- Integrity of completed maintenance welding
- Alternative or improved maintenance techniques

Program 3 Key 2003-2004 projects

- **Safety during in-service welding**
  - Continuing improvements in weld burn-through prediction and cooling rate models



Program 3 Key 2003-2004 projects

- **Integrity of maintenance welding**
  - Hardness prediction,realistic hardness limits and modelling of delayed hydrogen cracking

Program 3 Key 2003-2004 projects

- **Alternative or improved maintenance techniques**
  - Improved techniques for weld deposition repair - automated weld deposition repair on in-service pipelines and weld deposition repair adjacent to seam and girth welds

Program 4 Safety and Integrity Issues Related to Advanced Material Design

- Integrity issues for higher design factors
- Integrity issues in the construction and operation of high-pressure, high-strength pipelines
- Safety and integrity issues related to fracture in high-pressure, high-strength pipelines

Program 4 Key 2003-2004 projects

- **Assessing and specifying strain hardening behaviour in high strength steels**
  - strain-based design, hydrostatic test criteria
- **Gas decompression behaviour following rupture of high pressure pipelines**
- **Improvements to fracture propagation/arrest models**
  - Backfill coefficient, elastic contribution

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Where next?

- About $2 million of 2005 funding requirements already identified (on-going projects, new projects in existing programs that could not be funded in 2004)

Major challenges

- **To provide significant further reductions in the cost of major, long-distance pipelines in challenging environments**
  - welding costs are about 8% of total project costs
  - material costs are about 40% of total project costs

No magic bullet, but more of the same?

- Increased pressure ⇒ decreased diameter ⇒ decreased construction (and usually operation) costs
- Increased strength ⇒ decreased thickness ⇒ decreased material and construction costs
- More efficient welding processes ⇒ decreased construction costs, more consistent weld performance and more efficient use of scarce resources (human and equipment)

…and no nasty surprises!

- Practical and validated fracture control approach for high pressure, rich gas pipelines
- High productivity mainline and tie-in welding processes available for highest strength levels
- Appropriate defect detection and assessment methods (including strain-based design)
- Mechanical behaviour of high-strength materials fully understood (strain-based design, hydrostatic testing)

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