Collaborative R&D Roadmap for the Energy Pipeline Industry

Mark Piazza
Director, Pipeline Program
PRCI
PRCI Membership

- **37 Energy Pipeline Operating Companies**
  - 23 Natural Gas Transmission; 9 Liquid
  - 5 Liquid/Natural Gas

- **3 Pipeline Industry Organization (PIO) Members**
  - Association of Oil Pipe Lines (AOPL) /API
  - Operations Technology Development (OTD)
  - Electric Power Research Institute (EPRI)

- **28 Associate Members & Technical Program Associate Members**
  - Australia, Canada, China, Europe, Japan, Mexico, U.S.

- **Worldwide Research Organization**
  - 41 U.S. Companies
  - 27 Non-U.S. (Australia, Brazil, Canada, China, Europe, Japan, Mexico, Saudi Arabia)
Drivers to Develop Industry R&D Roadmap

- Awareness of the R&D Universe
- Multiple parties and interests
- R&D Funding challenges
- Instant gratification
- Staying the course and managing emerging issues
- Changing role of industry-government relations

Pipeline R&D

- National Labs
- DOT
- SBIRs
- DOE
- NASA
- DARPA
- NSF
- NIST
- SINTEF

- AGA
- AOPL/API
- ASME
- INGAA
- NACE

- PRCI-EPRG-APIA
- OTD/GTI
- NYSEARearch
- EPRI
- INGAA Foundation
- ITF/Deepstar

Internal Company R&D

Joint Industry Projects

Industry-sponsored R&D

Trade/Std Associations

Government

Academia

Leak Detection
CO₂ Pipelines
SCC research
Subsea Integrity
Drivers to Develop Industry R&D Roadmap

- Other Energy Interests
  - INGAA
  - AGA
  - EPRG
  - OS&E
  - INGAA Foundation
  - IMCI Teams
  - Trans Operations
  - Trans Engineering
  - Corrosion Control
  - Gas Control
  - Design Committee
  - Corrosion Committee
  - Materials Committee

- Integrated Energy Company

- Offshore
  - Onshore
    - Gas
      - INGAA
      - AGA
      - EPRG
      - OS&E
      - INGAA Foundation
      - IMCI Teams
      - Trans Operations
      - Trans Engineering
      - Corrosion Control
      - Gas Control
      - Design Committee
      - Corrosion Committee
      - Materials Committee
    - Liquids
      - CEPA
      - AOPL
      - API
      - PIWG
      - OTG
      - R&D WG
      - Multiple RP TCs
INPUTS & outcomes of the Current Process

Drivers & Inputs
- PHMSA
- State Gov't
- Local Gov't
- Advocacy Groups
- Public

Outcomes & Benefits
- CT DUT
- GTI
- SES
- EW
- CFER
- Battelle
- DNV

Drivers & Inputs
- Key Contractors
- Planning
- Stakeholders
- Industry Organizations
- Technical Societies
- Service Providers
- Pipeline Operators
- PHMSA
- State Gov't
- Local Gov't
- Advocacy Groups
- Public

Technology

Roadmap: Consensus to Focus Resources and Establish Deployment Routes

- In-Line Inspection
- CP/Coatings/Corrosion
- NDT / NDE
- Equip / Material

Biofuels/CO2/Ethanol
- Distribution
- Transmission
- Gas
- Haz. Liquids

API
- ASME
- NACE
- ASTM

PRCI
- AOPL/API
- INGAA/AGA
- SGA
- NYSEARCH/OTD
- APIA-EPRG
- IPLOCA
- CEPA
Developing the Industry R&D Roadmap

INGAA IMCI

AOPL/API
R&D for Pipeline Safety Improvement

Large Programs with Substantial Funding Commitments

PRCI is Conduit for Industry
- Gas, liquid, industry associations
Owner of R&D Roadmap
Continuous Feedback Loop

Identify R&D Partnerships
- NYSEARCH, OTD, APIA, EPRG, etc.
Monitor PHMSA R&D Program
Information Sharing & Repository
Communication & Deployment
Synergy Across the Industry - IMCI and PSIA

- Top R&D Needs
  - Improvements in ILI capabilities & Re-inspection intervals
  - Unpiggable/Difficult to Inspect Pipelines
  - ERW/Longitudinal Seam Welds
  - Leak Detection
  - Data Integration & Decision-making Processes/Tools
  - SCC & Cracking – welds and pipe body
  - Anomaly Assessment
  - Mechanical Damage & Damage Prevention
  - Facility Integrity
  - Risk Assessment

CONSISTENT with PRCI Programs and Roadmaps
The Tripartite Collaboration & Global Coordination

Fracture Control – Shock Tube Testing

Delayed Failure of Mechanical Damage

Reduced Construction & Installation Costs

Standards for Corrosion Assessment of Unpiggable Pipelines

APIA
- Materials
- Materials Performance
- Welding

EPRG
- Pipe Manufacturers
- Materials Performance

PRCI
- Integrity & Reliability
- O&M Facilities
- Integrity Management for Subsea Pipelines

Human Factors in Damage Prevention

SCC Experience Database

Corrosion Growth Rates

Pipeline Research Council International LEADING PIPELINE RESEARCH
NYSEARCH – OTD – PRCI COLLABORATION AREAS OF MUTUAL INTEREST

- Pipe Locating
- Plastic Pipe – Advanced Standards Devt, Modern Materials Testing, NDE Techniques for Joining
- Greenhouse Gas Emissions
- MD Prevention & Monitoring
- Internal & External Corrosion – Remote Inspection, Direct Assessment & Special Challenges
- Materials & Joining
- Pipeline Repair
- Underground Storage
- MD Inspection & Assessment
- New/Alternative Fuels – Compatibility & Transmission
- Measurement/Metering
- Compressors & Engines
- Stress Corrosion Cracking
- Pipeline Design
- Geotechnical Threats

Collaboration: to obtain future work, to access information from prior work, and to obtain relevant information and knowledge about current work
Broader View of R&D Roadmap

- **Corrosion**
  - Establishing Corrosion Growth Rates
  - Cathodic Protection Effectiveness and Criteria
  - Direct Assessment Methods – ECDA, ICDA, SSCDA
  - SCC Mitigation

- **Design Materials & Construction**
  - Strain-Based Design
  - Welding & Inspection of Welds – 21st Century Welding
  - RBDA
  - Materials – Composites and others
  - CO₂ Pipelines

- **Subsea Pipelines**
R&D Summits – Laying the Foundation

Session No. 1
Transforming the Model & Road Mapping the Journey; North American Industry Stakeholders

Feb 2012

Session No. 2
PRCI Technical Committees and North American R&D Organizations

Dec 2011

Session No. 3
Global Stakeholder Perspective and Beyond Inspection Focus

May 2012

Session No. 4
Collaborative R&D Panel IPC 2012

Roadmap Progression
Takeaways from Summit Sessions

- You say potato…
- “Step Change” & “move the needle quickly” –
- Industry is slow to adapt/change - challenges to technology development and application
- Balancing the R (or r) with the D&D
- Less is more (AD/HD) - Timely execution and R&D deployment
- Funding and Human Capital
- Evolution – where will the Pipeline Industry find protein in its diet
- Not a once and done effort
Roadmap Elements by Pipeline Life Cycle

QMI Process – Cradle to Grave

**Design**
- Strain-Based Design
- Harsh Environments
- Geohazards
- RBDA
- Siting & Environmental Impact
- Design for Inspection
- CO₂ Pipelines

**Manufacture**
- Manufacturing Processes
- Mill QA/QC
- Materials - High Strength Steels/High Performance Pipe

**Build/Construct**
- Modernizing Construction Practices
- HDD
- Line Lowering
- Line Transport
- Welding and Weld Inspection
- Field Applied Coatings

**Operations & Integrity Mgmt.**
- Damage Prevention
- Pipeline Inspection
  - ILI
  - In Ditch/NDE
  - Above pipe
  - Difficult to Inspect
  - DA
  - Re-inspection
  - CP
  - Coatings
  - Leak Detection
  - Emission Reductions
  - Data Integration

**Repair & Remediate**
- Anomaly Assessment/FFS
- Corrosion growth
- Crack growth
- Composite Materials
- Safe Practices for Inspection In Ditch

**Decommission & Abandonment**
- Lost but not forgotten

All Threats Managed Across Asset Life Cycle
Mechanical Damage Threat Management Research in PRCI - Simplified Roadmap

- Monitor Incident trends
- Damage Prevention (DP) by ROW Monitoring (ROW)
- Other threats: corrosion, SCC, etc.
- Research to Improve Integrity Management For Mechanical Damage
- NDE: Inspection Detect & Size MD1: 1-1, 1-2, 1-3
- Characterize, Discriminate features MD1: 6 projects
- Assess severity MD2, MD4
- Remediate MD5
- O&I
- DOT support
- DMC
- DOT support
- DOT support
- DOT support
- DOT support
- DOT support
# Mechanical Damage – Program View

## Projected Schedule

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<th>Year</th>
<th>2012</th>
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- **MD**: Mechanical Damage
- **ILI**: Intermittent Loss of Signal
- **$**: Costs associated with each phase
Mechanical Damage – Fishbone Diagram

Discriminating Critical Defects

Engineering Assessment
Critical vs. Benign
Fitness for Service
RSTRENG equivalent for MD (3)

Field
SCADA Detection

Change detection algorithm (Change in Profile, signal, etc.) (4)
Increase Frequency (Sponge Sensor) (1)

Validation
(IL), Ditch, Technology

Repeatability cracks in deformation (1)
Deformations (w/Cracks, Gouge)
Sensor Lift off (1)

Remote Sensing Technology
New Technology on newly built pipelines (5)
Intelligent pipes

Assessment

Full Discrimination
Dent+Cracks
Dent+Gouge

Technology Performance Assurance (1)

Obstacles
Material Properties Uncertainty, Effort,
Economics, Business case

Recognized damage management protocol,
Full discrimination of features – identify
Cracks in defects and dent +gouge
Reliable material property data thru ILI,
Sensor conformance for deformation

End Point
What’s Next for R&D Roadmap

- Writer’s cramp
- Roll-Out and Execution
- Coordination with all Stakeholders
- Walking the Walk
- Developing an Effective Method for Monitoring R&D
Now Its Your Turn

- What are the key challenges facing the pipeline industry and how can R&D be more effectively implemented to address the challenges?
- Does your company/organization support pipeline R&D? If not, why not?
- What role should government play?
Now It's Your Turn

- Is there a sufficient understanding of the work being performed in the R&D community and the work being performed and its impact on the industry? How do we better deploy R&D outcomes?

- How do we ensure that all of the organizations (with their own unique identities and needs) work together to advance the most critical R&D issues for the industry?
Closing Slide

Thank you for your attention
Questions?

Follow-up questions or information needed:
Mark Piazza
mpiazzza@prci.org
678 339 3645