

Pipeline Research Council International

Achieving Alignment and Advancing Pipeline Research

*Challenging Industry Leadership to Make Research
a Top Priority*

IDT Expo
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PRCI Research Steering Committee



LEADING PIPELINE RESEARCH



Opening Statements

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- Pipeline safety programs are robust and continue to mature and evolve as lessons are learned and continuous improvement practices are applied
- All actions involve risk... no action or operation is risk-free
 - Zero is a Goal
 - 6σ
- The pipeline industry discovers and repairs far more injurious conditions than those that lead to failure and loss of containment...
- ...but there is a recognition that we need to improve





Current State of the Industry

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- **Evolution & Growth of Pipeline Infrastructure**
 - Global energy supply and demand at an all time high and continuing to expand – reliability, security needs increasing
 - Shale Gas, Oil Sands, frontier/remote areas, deep water
 - New infrastructure and transportation modes for new energy sources and exports – natural gas, LNG, petroleum
- **Government Oversight and Public Accountability**
 - Error-free, leak-free operations
 - Pipelines are now social/political – greater public awareness
 - Demands for transparency and access to information
- **How does the industry meet the demands?**



Established in 1952...

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Established as a committee in the American Gas Association to Solve Long-running Brittle Fractures

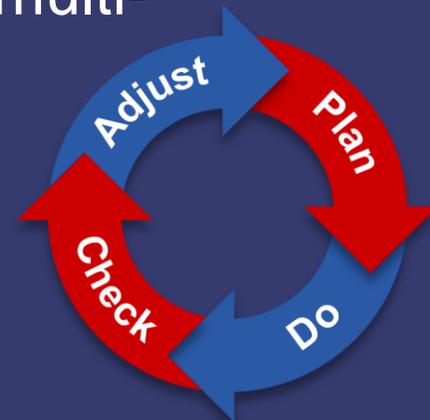


Pipeline Research Assessment

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■ EB/EA Challenge to PRCI Membership

- Following Pipeline Safety Management Systems process, an evaluation of the PRCI research program and process for developing the program was needed
- Plan-Do-Check-Adjust: Assess the current approach and make adjustments where they are needed
- New Funding Model – SRPs and additional, important research
- SRPs – high impact, high value industry topics; broader view; multi-disciplined; improved member engagement





Industry Strategic Initiatives

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- **AOPL/API establish set Strategic Initiatives on 3-year frequency**
 - Promote Organizational Excellence
 - Enhance Emergency Response Preparedness
 - Increase Stakeholder Awareness and Engagement
 - **Improve Safety Through Technology and Innovation**

- **USDOT PHMSA Research Focus Areas (2019 RA)**
 - Damage/Threat Prevention
 - Anomaly Detection & Characterization
 - Remote Sensing/Leak Detection
 - Liquid Natural Gas
 - Materials

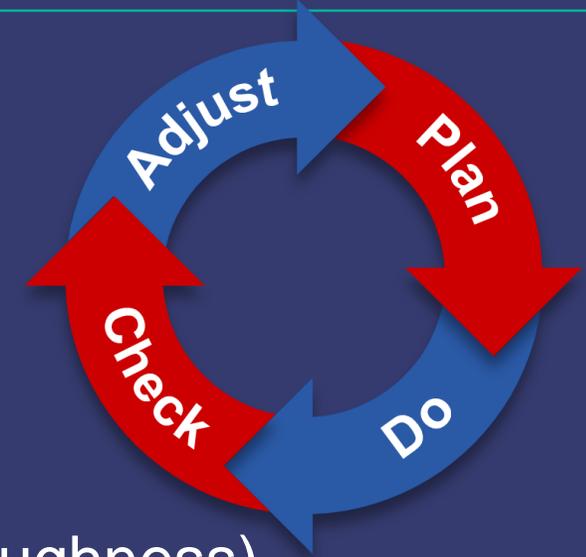
- **PRCI Research Objectives**



Industry Approach to Research

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- **Incremental improvements is status quo**
 - Prior Standard approach – PRCI research ballot
 - Necessary, but has limitations
- **Step-change**
 - Driven by immediate need or passionate champion
 - Very rare in the industry (in-ditch material properties & toughness)
- **Disruptive technology**
 - What is the iPhone and Uber for the industry?
- **Focus shift needed – challenge the industry to “adjust”**
 - Strategic Research Priorities
 - Delivering meaningful results to the industry





New Research Funding Model

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- **Challenge the industry to “adjust”**

- **Focus on Strategic Research Priorities**
 - Stakeholder outreach and engagement – includes you
 - Objective metrics to identify/prioritize
 - Resource alignment across industry – people and money
 - Focus energy on delivering high impact results

- **Increasing role and relevance of the Research Steering Committee**



Leveraging Opportunities

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- PRCI Technology Development Center (TDC)
- Expanded collaboration with external stakeholders
- Deliberate alignment with PHMSA, DOE R&D – 2020 R&D Forum
- Member company internal R&D programs
- University research resources and expertise



PRCI TDC – brings it all together

- Access to many real-world features
- State-of-the-Art pull test facility
- CONTINUOUS IMPROVEMENT



Roadmaps for Strategic Issues

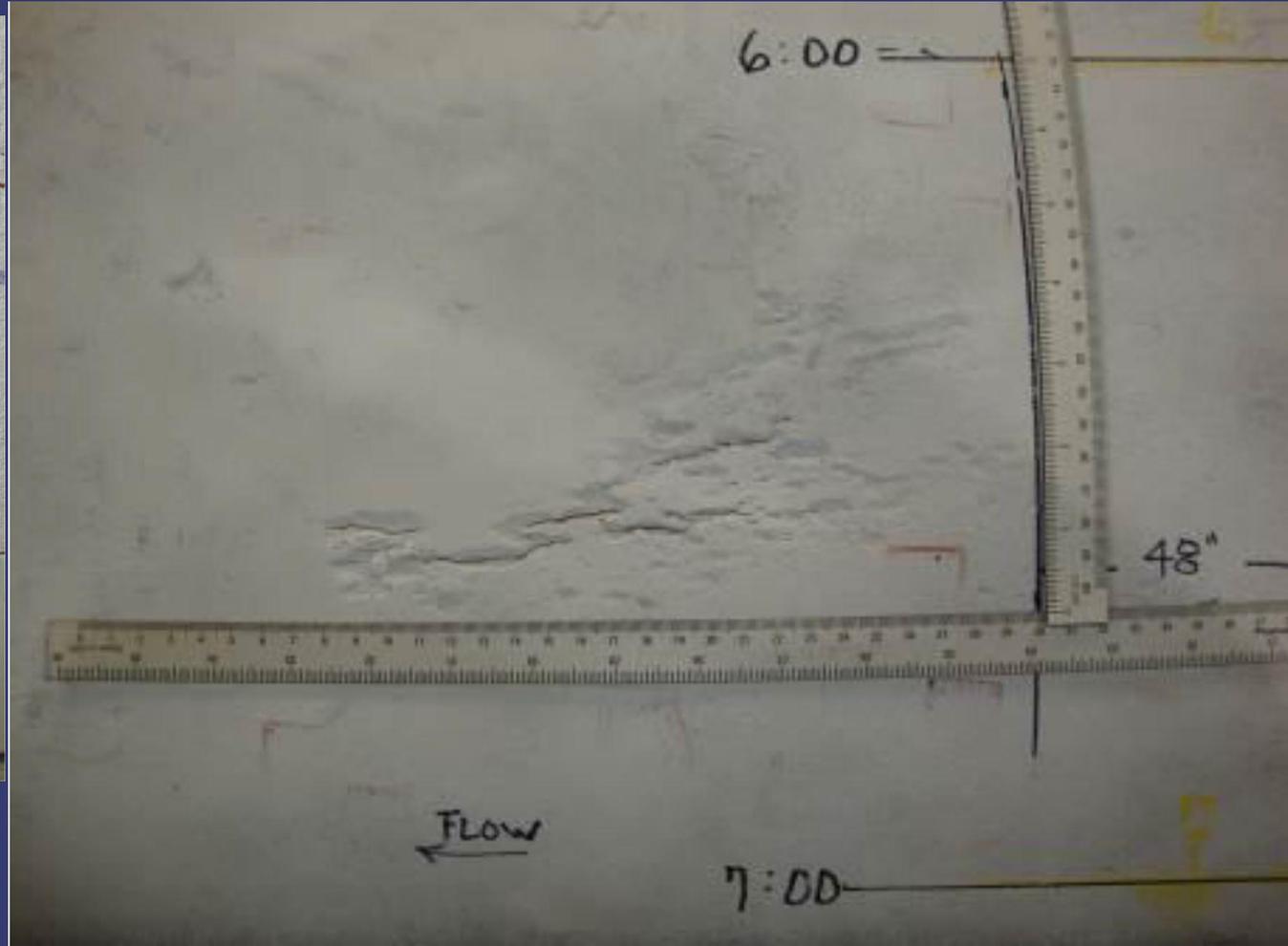
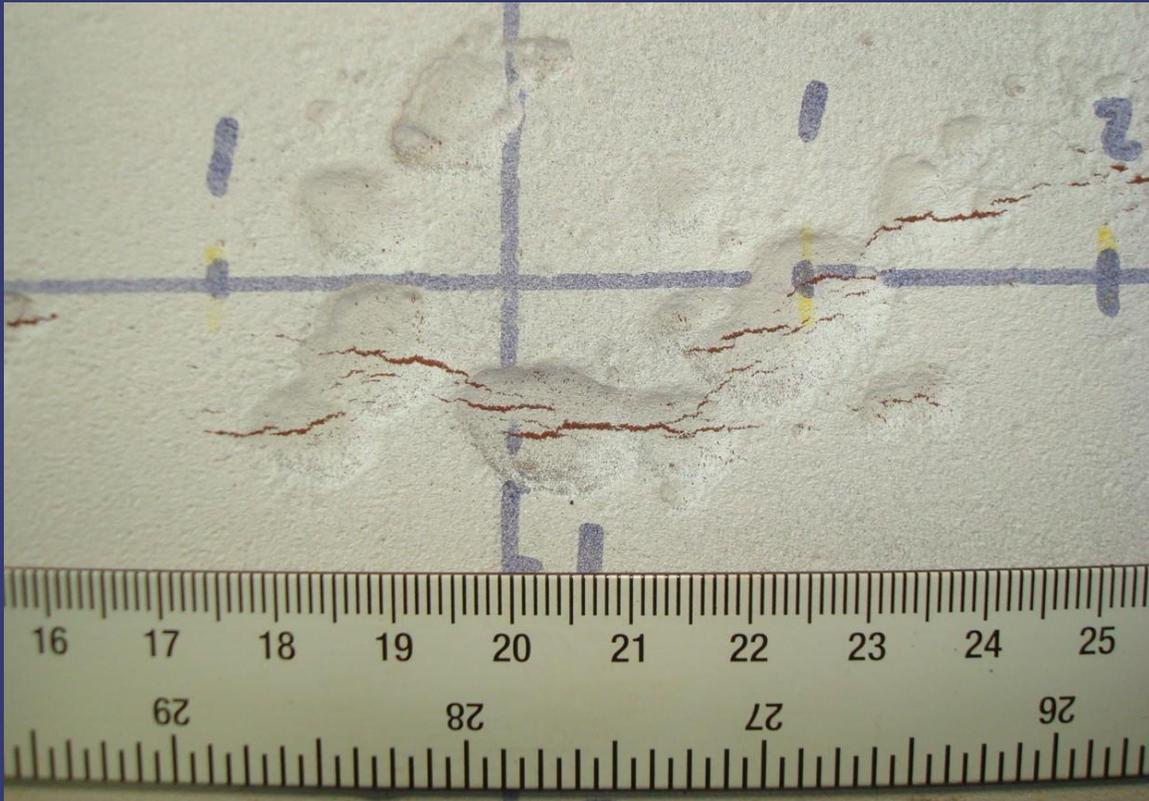
Composite Technology Roadmap					
Pipeline Anomaly, Technical Issue, or Feature	PRCI Research	Actual Field Experience	Guidance from Standards (ASME & ISO)	Independent Research	Average
External corrosion in straight pipe <80% (Non SBD)	3	3	3	3	3.0
Plain dents subjected to cyclic pressure (PCC-2 appendix is being developed based on PRCI data)	3	3	2	3	2.8
Dents with metal loss subjected to static/cyclic pressure	1	1	1	2	1.3
Dents in welds (seam and girth) subjected to cyclic pressure	2	2	1	2	1.5
Dents with gouges	2	2	1	2	1.7
Seam weld defects	1	2	1	2	1.5
Vintage girth welds (pressure, tension, bending) including cracks	3	2	1	3	2.3
Wrinkle bends	3	3	1	3	2.5
Reinforced branch connections (above and below ground)	1	3	1	3	2.0
Elbows and bends	1	3	2	3	2.3
Forged Tees	1	3	2	3	2.3
Subsea Diver Applied installations	3	2	1	2	2.0
Diverless Subsea Installations	1	1	1	1	1.0
Internal corrosion (non-leaking)	1	2	2	1	1.5
External Stress corrosion cracking (SCC) (w/o grinding)	1	2	1	2	1.5
External Stress corrosion cracking (SCC) (with grinding)	1	3	1	2	1.8
General Corrosion loss >80%	1	1	1	3	1.5
Pitting >80% combined with uniform corrosion <80%	1	1	1	1	1.0
Up-rating (re-rating) pressure / Establishing MAOP	3	1	1	2	1.8
Effects of pressure during installation (included in MATR-3-11)	2	1	2	2	1.8
Repair of leaks after shutdown	1	2	2	2	1.8
Live Repair of leaks (stopgap leak repair incorporated in to composite repair)	1	2	1	2	1.5
Effects of cyclic pressure on corrosion (fatigue design) (included in MATR-3-11)	2	3	1	2	2.0
Performance at elevated temperatures (Threshold temperature open for discussion; GRE pipes which 65C as the threshold)	1	2	2	3	2.0
NDE Techniques and Defect Acceptance Criteria to look at Composite Material	2	1	1	2	1.5
NDE techniques to examine substrate below composite when IU is not possible	1	1	1	2	1.3
Load Transfer & Delamination/Disbondment	2	2	2	2	2.0
Validation of PCC-2 Design for High Grade Steels (X65+)	1	1	1	1	1.0
Detection of NMR's by ILI	1	3	1	1	1.5
Post-Cutout Assessment Activities	1	2	1	2	1.5
NEW Composite crack arrestors for high pressure gas pipelines	3	2	1	3	2.3
QA/QC Requirements - understand the impact of deviations in installation. Human Dimension & Training.	1	2	3	2	2.0
Improve buckling resistance of pipes subject to geohazards	1	1	1	1	1.0





Integrating Research Opportunities

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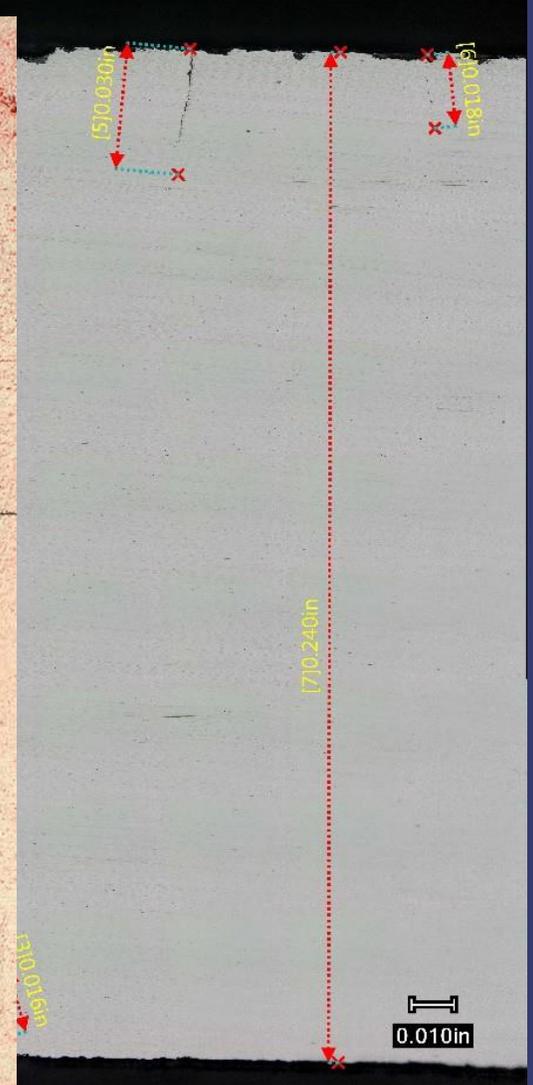
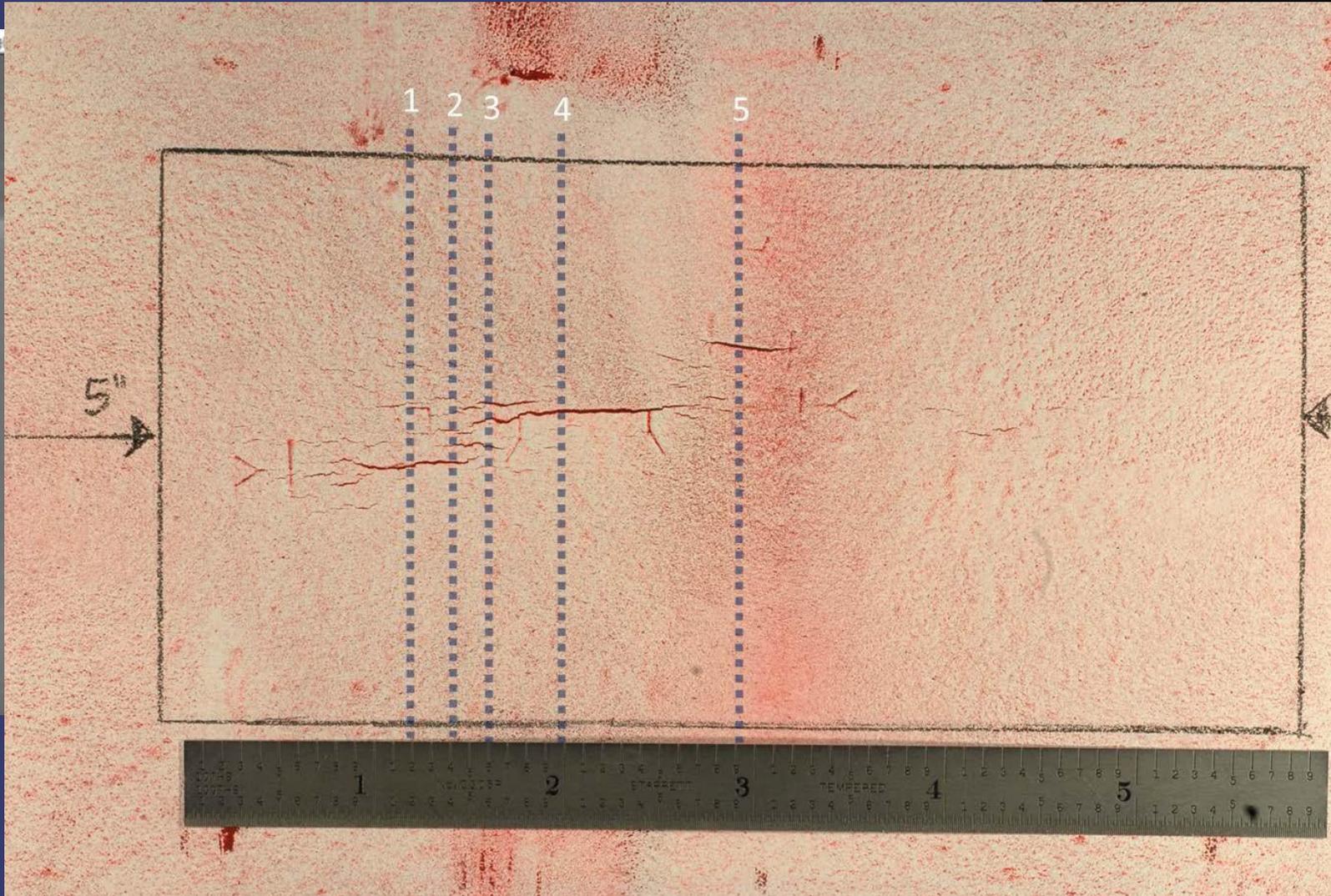




Integrating Research Opportunities

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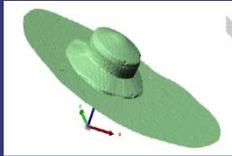




Industry Reference Inventory

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Calibration Standards



Calibration samples specifically tailored to in-service damage

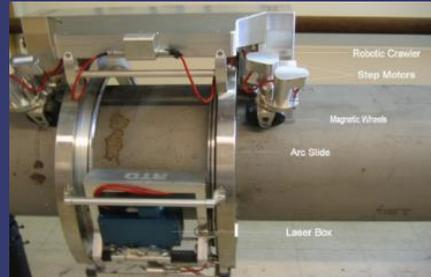
Most calibration standards designed for manufacture and construction:

- EDM notches
- Side Drilled Holes
- Dents, MD

Create new standards and new reference points – NIST methods and PHMSA R&D proposal.

- Crack reference stds.

Reference Standards



Determining the baseline of the flaws or establishing a fixed reference point is crucial - data point against which all other data will be measured.

Physical sectioning

Using multiple techniques to determine a reference point

Real-world Features



Range of damage morphologies

- Mechanical damage – dents, dents with gouges, dents with gouges with cracks
- External Wall Loss
- Internal Wall Loss
- SCC
- ERW
- Fatigue Cracks
- Flexible risers
- Vintage Girth Welds
- CUI

Surplus Materials for fabricating features



Integrating Research Opportunities

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- **XRCT**
 - Results from past studies
 - Recent evaluations of commercial XRCT equipment
 - Truth data and reference standards
 - Fatigue cracks, other features for testing
- **NDE qualification/competency – ASNT, API, PRCI**
- **Crack Management, Dents, Corrosion**
- **Calibration and reference standards – shouldn't this be a focus for the industry**
 - Seam anomalies
 - Cracks, crack colonies
 - Dents, dents with fatigue cracks, dents with corrosion, dent+gouge
 - Corrosion – leverage creafom data, complex corrosion, pinholes, pitting within pitting;



Closing Thoughts

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- Pipeline safety programs are robust and continue to evolve – continuous improvement is truly continuous and never ends

Improvements in pipeline safety can be attained through:

- Investment in people and optimizing and continuously improving the technologies and processes
- Safety Culture
- Innovation, new approaches, new technology
- Data mining and advanced analytics
- Industry leaders & leadership – make research a priority (\$)
- Collaboration

PRCI is positioned to lead the industry



Questions

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- **What is a sufficient annual funding level for pipeline R&D?**
- **What role should the government play in funding R&D?**
- **What is the value of changing the public perception?**
- **How do we better integrate cross-over technologies?**
- **Inspection technology has improved defect definition capability compared to 20+ years ago but where do we go from here?**
 - **Push limits of current technology – blood from a stone?**
 - **New technologies – costs, timing**
 - **Higher funding, bigger programs, significant impact**
- **Perception – How does the industry more effectively communicate its message? Advocate virtues and benefits of industry?**