

Pipeline Research Council International, Inc.

Panel 2: Current Industry Research

-PRCI R&D Program

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PHMSA R&D Forum
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Pipeline Research Council Int'l. Overview

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■ Membership

- 39 Pipelines, over 350,000 miles of transmission pipe
 - *Natural Gas and Hazardous Liquids Pipelines*
 - *Membership generally at the Pipeline holding company level*
 - *27 members are North American based*
 - Remainder: Europe, Brazil, China, Saudi Arabia, South Africa
- Energy Industry Associations: AOPL, OTD, EPRI
- 37 Technical Program Associate Members
 - *Key equipment and service providers to pipelines. Pipe mills, ILI vendors, Integrity mgmt service co's, Compressor engine mfr's*

■ Funding

- Annual subscription based on pipeline mileage
 - *2014 R&D program size: \$ 9.6 Million*

PRCI Research Program Structure

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▪ R&D Program Content

- Determined annually via a research “ballot” that is a menu of funding requests for specific projects and programs from six Technical Committees
 - Project ideas identified in winter/spring
 - PRCI Board votes over the summer – finalizes in September

▪ Technical Committees comprised of member reps

- Identify, screen & propose potential research projects
- Project teams select contractors & approve workscopes, provide general project oversight, provide peer review of results, and approve results on behalf of PRCI

Pipeline Technical Committees **81% of 2014 \$**

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▪ **Operations & Integrity (\$5.4 MM)**

- NDE Technology Development & Inspection Methods
- ROW Protection & Monitoring, Leak Detection
- System Integrity Management (ERW & Long-Seam)
- Control Room Operations & Human Factors

▪ **Design, Materials & Construction Committee (\$1.5 MM)**

- Materials & Metallurgy (line pipe materials, fracture mechanics)
- Welding Practices & Weld Inspection
- Design & Construction (loadings, geo-hazards, offshore)
- Pipeline Repair Technology & Procedures

▪ **Corrosion Committee (\$ 900K)**

- Detection, Assessment & Management of Galvanic Corrosion & SCC
- Improvement of Cathodic Protection Design & Operations
- Quantitative Risk Assessment – Structural Significance of Defects

Facilities Technical Committees

19% of 2014 \$

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- **Compressor & Pump Station (\$ 950K)**
 - Reciprocating Engine Emissions Compliance
 - Greenhouse Gas Emissions Reporting & Mitigation
 - Engine Reliability & Condition Monitoring
- **Measurement (\$ 750K)**
 - Ultrasonic Meter Installation, Diagnostics & Recalibration
 - Adapting Measurement Practices for Shale Gases
 - Expand the Operating Range of Meters
 - Generally Improve Custody Transfer Accuracy
- **Underground Storage (\$ 200K)**
 - Storage Field Integrity – ILI tool performance
 - Brine string integrity (salt cavern storage)

2015 R&D Ballot – Open for Voting

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- **117 Projects Identified**
 - 11 Research Programs plus 79 individual projects
 - \$ 20.6 MM of funding requested
 - \$ 7.9 MM requested in Programs
 - ***\$6.1 MM of which are in Pipeline Integrity Programs***
- **Continues the long tradition of more needs, wants and ideas than money**
- **Annually ~70 to 80 projects are funded**
 - 80% of these are Pipeline Integrity-related

O&I Committee Overview

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Underline = Program

- **NDE & Inspection**
 - **ILI in the Pipe**
 - **NDE-1 (girth welds)**
 - **NDE-4 ILI Improvements**
 - **In Ditch NDE Tools – NDE-2**
 - **Pipe Sample Defect Characterization – NDE-2**
 - **Tools for Difficult to Inspect PL's – NDE-3**

- **Damage Prevention & ROW Monitoring**
 - **RAM Program – ROW-3 & ROW-6**
 - **Human Factors – DP-3**

O&I Committee Overview

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- **Leak Detection – PL-1**
- **ERW & Long-Seam Pipe – IM-3**
- **Detect & Discriminate Mechanical Damage – MD-1**
- **Structural Significance of Mechanical Damage – MD-4**
- **Subsea Pipelines – SPIM-1 & SPIM-3**

NDE-4A: Pipe Properties Using ILI Technology

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Pattern recognition for MFL data – a change is noted as pipe properties change

What is the nature of the discrepancy? Diff't MFL sensors give different responses

Pipe properties?

Yield Strength?

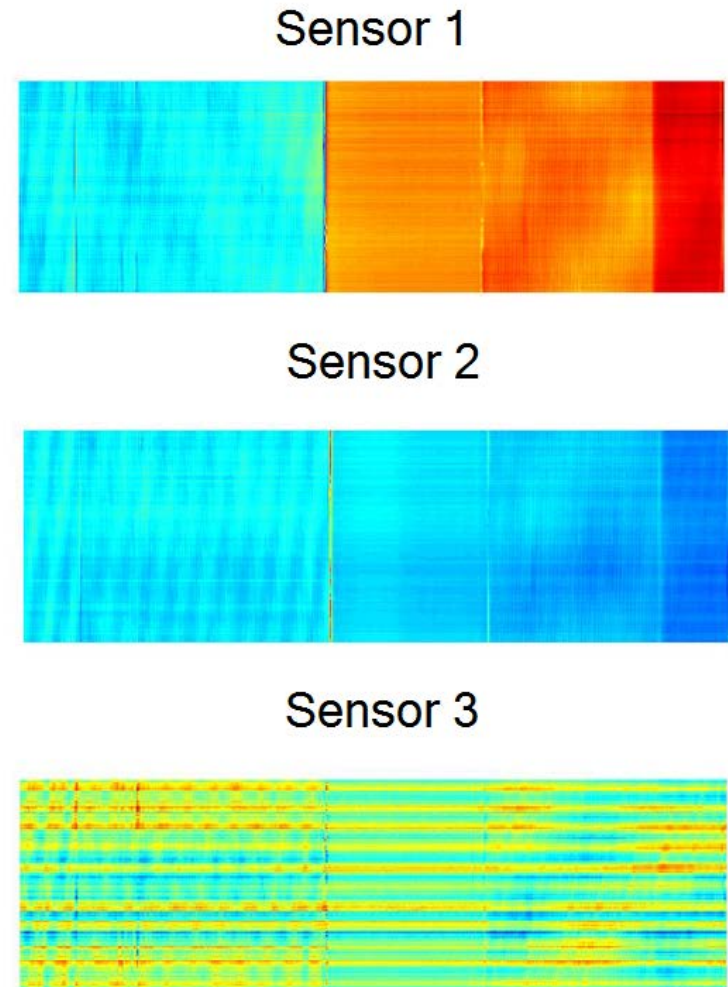


Figure 1: Raw data recorded by a Magnetic Flux Leakage (MFL) in-line inspection (ILI) tool run in three joints of an operating pipeline.

Machinery Threat Detection on ROW

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- PRCI Right of Way (RAM) Program – machinery threat detection and leak detection and reporting during routine pipeline aerial patrol
- Present focus is fixed wing aircraft, though drones are likely long-term option

RAM CONOPS Approach:

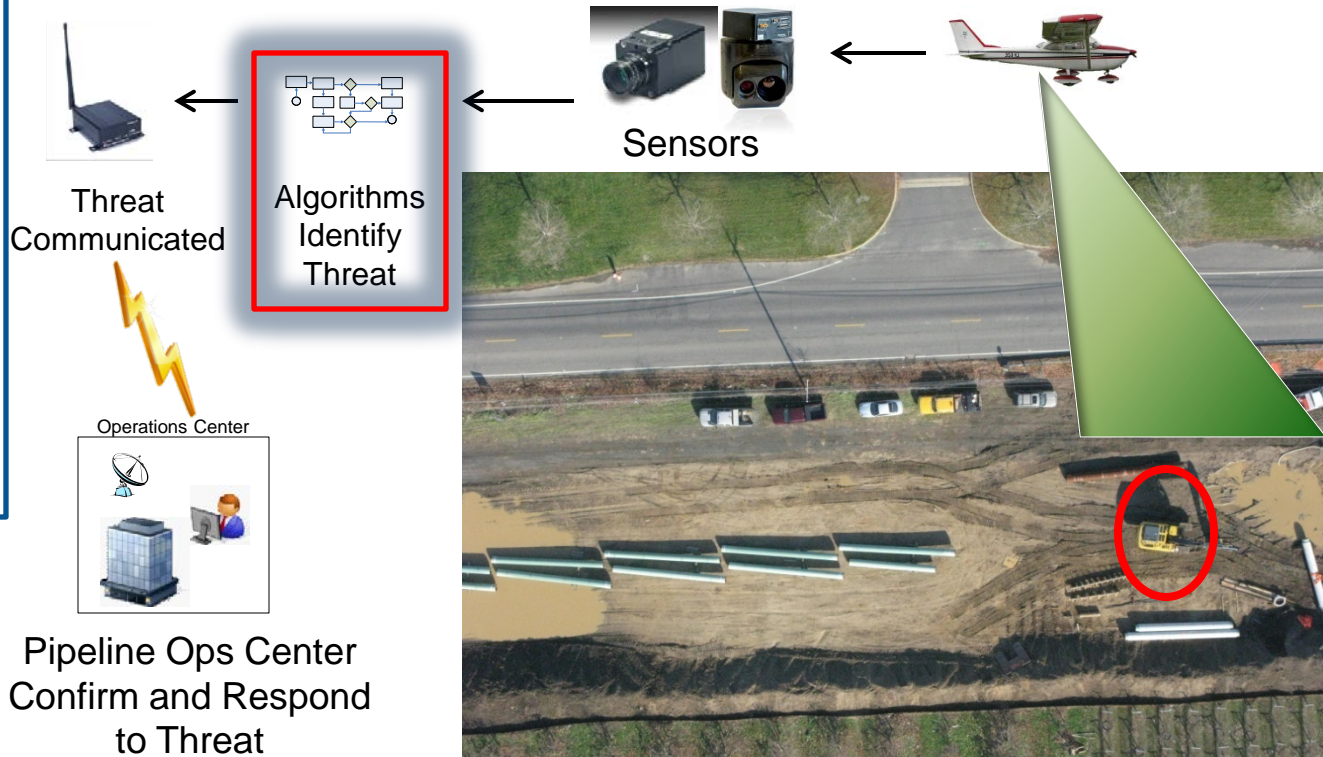
Detect – sensing & imagery collection

Process - data analysis via algorithms

Distribute – communication

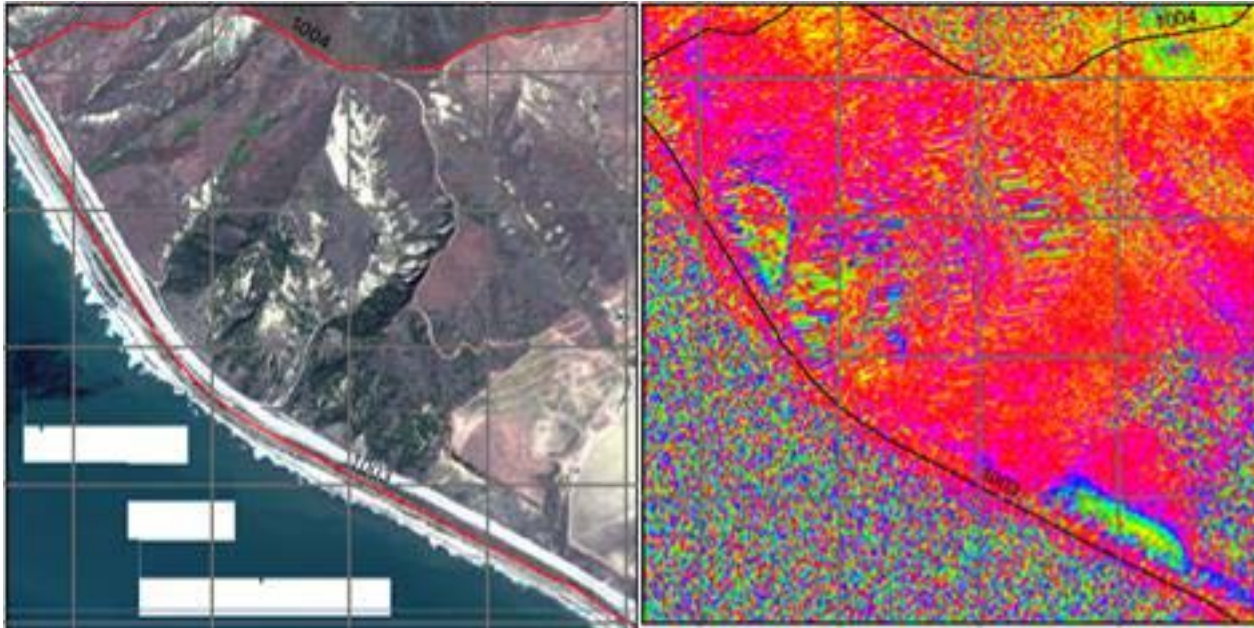
Archive – improved data management processes and predictive modeling

Fixed wing now – future view to UAVs & Satellite



Satellite Monitoring – Ground Movement

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Erosion and slumping images along a coastal highway generated from radar interferometric measurements from space that are processed through a sophisticated algorithm.

Local Monitoring – Ground Movement

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Ground Based Synthetic Aperture Radar Monitoring of Slope Stability along Pipeline ROW

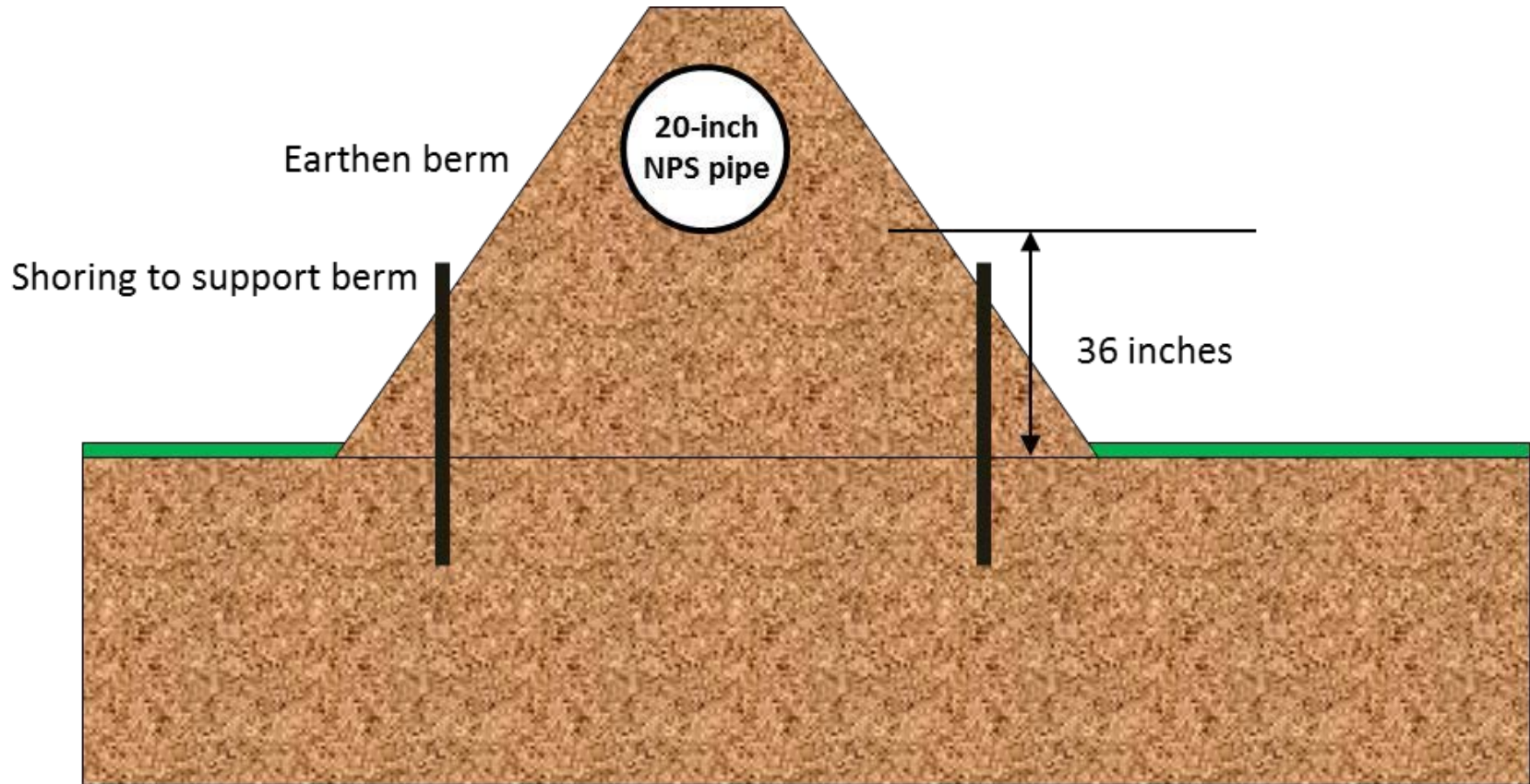
NDE-3: “Difficult to Inspect” Segments

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- **Project to assess Large Standoff Magnetometry (LSM)**
- **LSM devices offer the promise of assessing pipeline condition from above ground, through significant cover**
- **The market has a number of techniques using similar base principles known by their acronyms:**
 - **MTM – Magnetic Tomography Method -Transkor**
 - **MMM – Magnetic Memory Method - Energydiagnostika**
 - **SCT – Stress Concentration Technique - Speir Hunter**
- **Virtually all the data rests with the technology providers – little to no independent verification or documented use of these tools.**

Test Bed to Evaluate External NDE Tools

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Corrosion TC – Active Programs

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External Corrosion

***EC-1** Reliability-Based Integrity Management Program

EC-2 Structural Significance of Corrosion Defects

EC-3 Coatings Performance and Effectiveness

EC-8 Cathodic Protection System Performance

Stress Corrosion Cracking

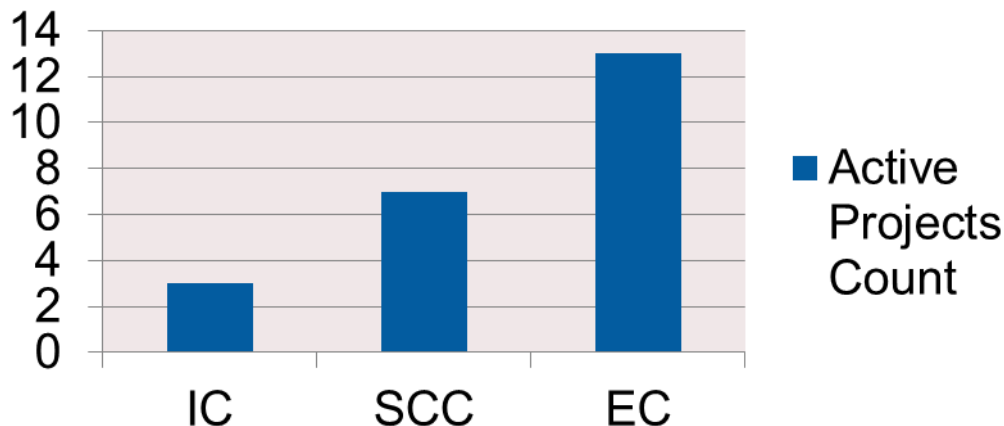
SCC-1 Site Identification and Re-Inspection Intervals for SCC DA

SCC-2 SCC Susceptibility Evaluations

SCC-5 SCC Mitigation and Repair

Internal Corrosion

IC-1 Internal Corrosion Threat Assessment



DMC Emphasis Areas with Focus

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Design and Assessment

- Improved basis-of-design
- Subsea pipelines
- Evaluation of external loading
- CO2 pipelines and equipment

Strain Based Design and Assessment

- Design for new pipelines
- Assessment of existing pipelines

Materials

- Improved pipe materials – properties and quality
- Corrosion resistant alloys
- High strength steels
- High performance materials

DMC Emphasis Areas with Focus

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Welding

- Codes, standards, testing
- Improved properties, productivity and quality
- Weld procedures/ In-service welding

Construction

- Improved construction productivity and quality
- Inspection
- Route selection

Assessment and Repair

- Damage assessment
- Repair methods - sleeves, composites, etc.

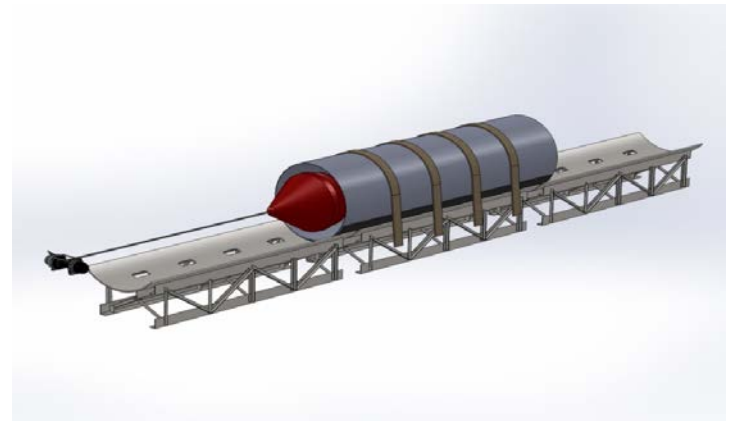
Fracture

- Fracture initiation, propagation and arrest
- Assessment of weld flaws

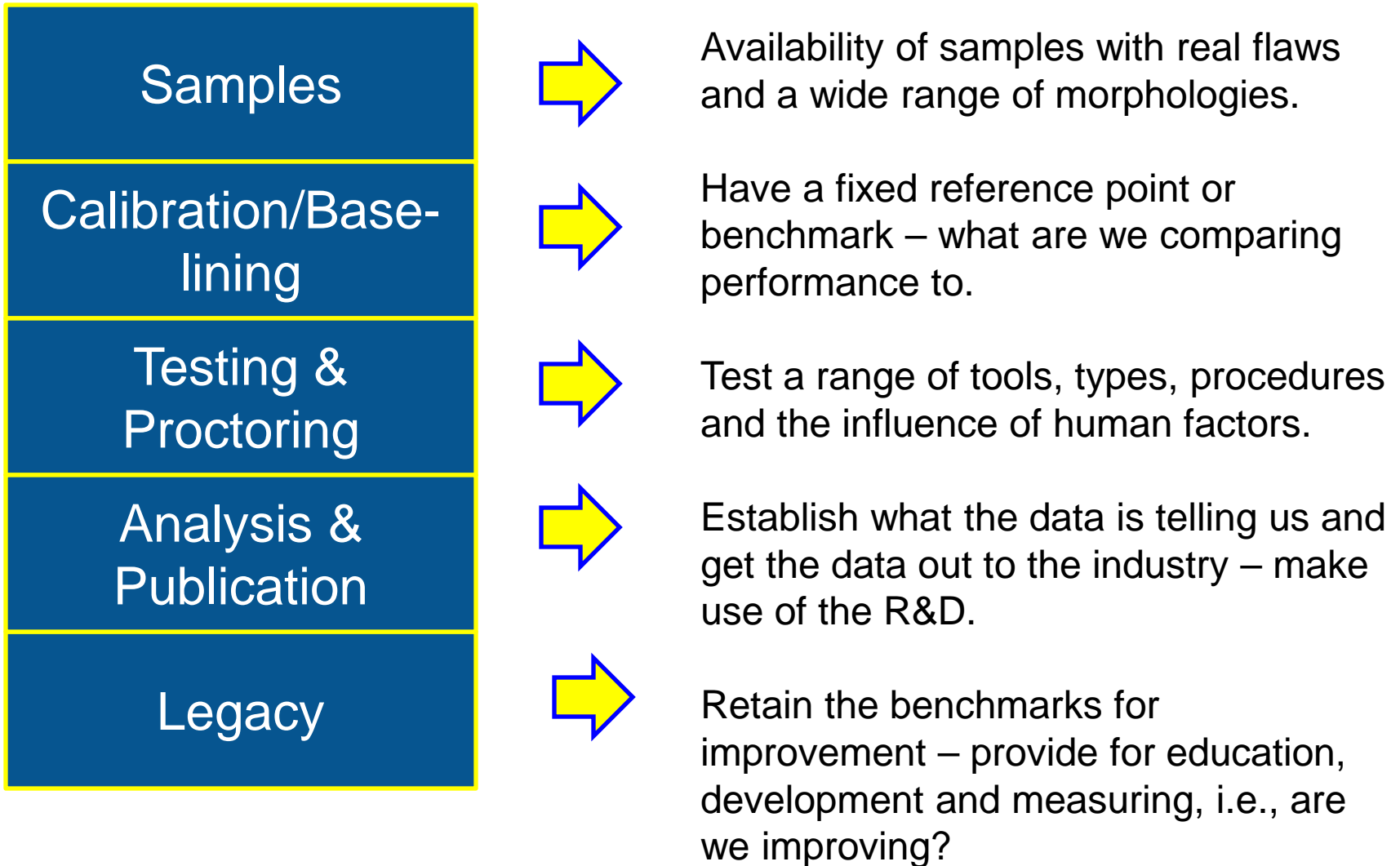
PHMSA - ILI Enhancements Project

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- PHMSA R&D project award – September, 2013
- Development of Industry test facility and Qualification Processes for ILI Technology Evaluation & Enhancements
- Build Pull Test Rig – Develop ILI Verification Process (not develop an ILI tool specification)
- Use of Samples with known defects – but continue to gather and characterize add'l features
- Conduct ILI tool runs with ILI vendor participation
- Responsive to NTSB Recommendation to assess ILI performance



Key Components of the ILI Test Program



PRCI Sample Repository

(Technology Development Center in 2015)

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- Established a facility in Houston that provides storage and working areas for full scale pipe samples.
- Currently ~660 pipeline damage samples – unique in the world
- A safe, accessible, working environment to enable independent trial, development and performance testing of NDE concepts
- Maintain custody & confidentiality key samples to ensure accuracy
- Reference standards, baseline samples & real-world samples



Additional Inspection Capability

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- **Pigging Loops installed in 2013**
 - 18 inch and 10 inch Loops transferred from Subsea Integrity Group (UK)
 - Initially hosted dry crawler tests
 - Known defect inserts can be fitted into the loops to test ILI equipment.



PRCI Technology Development Center

Major Commitment by PRCI July 2014

Langfield Road External Rendering

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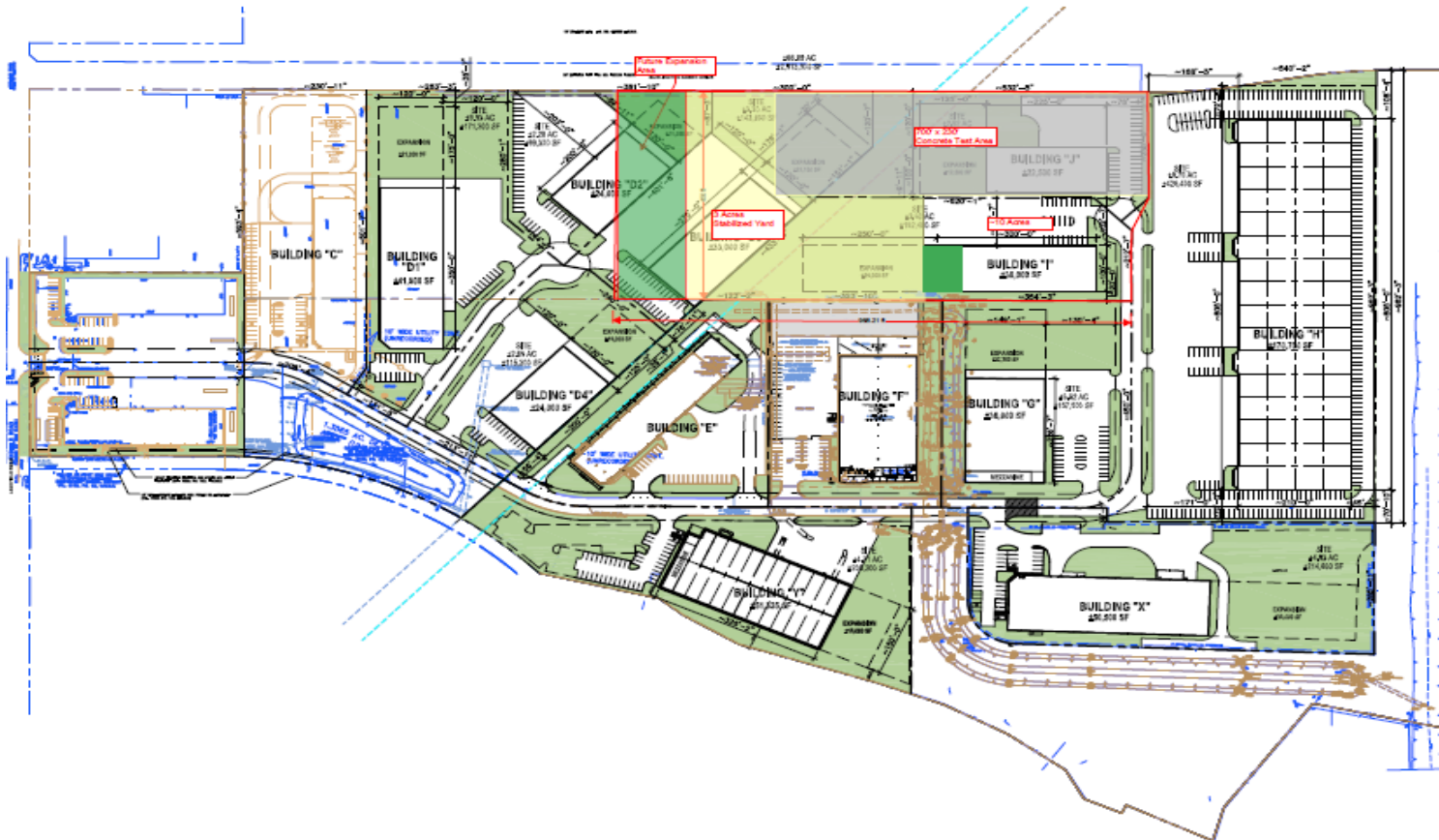


30,000 sq.ft. building with 20,000 sq. ft. workshop area and ~10,000 sq. ft. of offices and meeting space

Target opening date: February, 2015

Langfield Road

8 acres including 600" pull test rig, and 5 acres pipe storage and crawler loops





Thank you. Questions?



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