Working Group 3
Anomaly Detection/Characterization

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Government/Industry Pipeline R&D Forum, Rosemont, Illinois , Aug 6-7, 2014

Attendance Breakdown

Approximate total attendance	50 persons
Federal Regulators	1-3 persons
State Regulators	0 persons
International Regulators	0 persons
Pipeline Industry/Service Providers	35-45 varied
Standard Developing Organizations	0 persons
Researchers	4-7 varied
Academics	1-4 persons
Other	0 persons

Top 5 Identified R&D Gaps

Gap #1 – Non-destructive methods for Determining Material properties – ILI & in ditch; signal library and materials database. The tech should work on all steel pipes and hit the market in 3-5 years. (Technology, Consensus Standard and General Knowledge)

Gap #2 – Improve ILI technology for coincident and challenging features – girth welds, dents with cracking and corrosion, seams. The tech should work on all steel pipes and should have functionality and or performance requirements for precise Probability of Detection and Probability of Identification of many complex features. Possible roadblocks around intellectual property and lack of adequate field characterization should be factored. Improvements to the market in 1-3 years. (Technology)

Gap #3 – Improve NDE performance/reliability through reducing human effects on NDE measurement systems. The tech should work on all steel pipes and should have functionality and or performance requirements for improved reliability of existing Non Destructive Evaluation (NDE) techniques. Possible roadblocks around intellectual property and lack of consensus on existing NDE "gaps" development of more automated NDE processes, timing for new technology development should be factored. Improvements to the market in 1-3 years. (Technology and General Knowledge)

Top 5 Identified R&D Gaps (cont)

Gap #4 – Develop/Enhance Inspection Technology for small diameter (2”-8”) and Difficult to Inspect pipelines. The tech should work on all pipeline material types and should have functionality and or performance requirements for Identification and characterization of pipeline defects, especially cracks with a focus on small diameter pipelines. Possible roadblocks around miniaturization of sensors and supporting hardware/power requirements should be well factored. Improvements to the market in 1-3 years. (Technology)

Gap #5 – Pressure Test Design Guidelines – reliability, spike tests, destructive/damage, integration of inspection data, etc. The work may result in an industry document and should be coordinated with Standards Developing Orgs. Project scope should work around consolidating industry knowledge and develop guidelines. The results should be applicable to all pipeline types in all operating environments. Results are needed as soon as possible but 1-3 years is realistic for full uptake. (Consensus Standard and General Knowledge)

Report from Working Group #3
Anomaly Detection & Characterization

PHMSA R&D Forum
August 6-7, 2014
Chicago, IL

Overview of Session

- ~50 participants – operators, technology developers, service providers, academia, regulators
- 4 topic areas covered:
  - ILI
  - In ditch NDE
  - Difficult to Inspect Pipelines
  - Use and application of hydrostatic testing

- Introductory presentation on each topic area
- Collection of ideas and identification in terms of time frame for completion
- Wrap up session to consolidate ideas, rank topics for advancing recommendations, and consider other Working Group cross-over

Day 1 Session A – In-Line Inspection

- ILI for Material Properties
  - Sensing technology for pipe properties – stress, mechanical, chemical, micro-structure
  - Grade, seam, toughness are targets
  - Pipe body and welds
  - Can apply exclusion – what a pipe is NOT based on data (applies to below topic also)

- Protocol for Verifying Material Properties
  - Current industry efforts on using ILI for identifying discrepancies in pipe joints, binning of pipe based on similar “signals”
  - after identifying a segment/section of pipe that is “different” or where records are absent, establish a process to characterize the properties
  - DA-like guidelines (ILI DA)
  - Characterization option and frequency of sampling
  - Capitalize on exiting tool capabilities and provide flexibility in the process to accommodate new ILI technology

Day 1 Session A – In-Line Inspection (2)

- Effective Identification of CoinciDENT Metal Loss and Cracking in Dents
  - Leverage current work – PHMSA and PRCI
  - Support code and regulatory updates
  - Use ILI pull test facility
  - POI – corrosion and fatigue cracks

- Detect and Characterize (POD & POI) Girth Weld flaws, imperfections, anomalies, and defects

- More “direct” measurement of wall defects
  - Propagation of beams, angle vs. straight on
  - Wall thickness for gas pipelines

Day 1 Session A – In-Line Inspection (3)

- Comparative Signal Library
  - Use existing industry test samples and establish signal library, use well characterized samples
  - Model after prior work by Queens University for Mechanical Damage signal from MFL tools; expand to all features types
  - What does 1961 Lone Star ERW look like?

- Enhanced Characterization of Data
  - BIG Data solutions
  - Capitalize on computing capabilities
  - Evaluating multiple ILI runs from different technologies, vendors, and algorithms
  - Signals and patterns are there, how do we better extract and leverage the available information

Day 1 Session A – In-Line Inspection (4)

- Develop Technologies for detecting cracks in small diameter pipelines (2”- 8”)
  - Develop and test sensors
  - Platforms developed, just need to put them together and engineer solution with new/existing sensors
  - Primarily gas distribution but some transmission assets need these tools also
  - Sensor “burden” on platforms
- State of the Art Report on ILI Tool/Technology Performance
  - Standard ILI, emerging technologies, difficult to inspect
- Tool to characterize for fittings, valves, other appurtenances – material properties link

Day 1 Session B – in ditch NDE

- Competency Testing of Personnel
  - NDE, ILI (?)
  - Need Performance Demonstration standards
  - Research or industry standards organizations issue?

- Develop in ditch technologies with less human interaction
  - Initial effort may need to include a study on human factors that influence NDE data
  - Use results of above to engineer solutions that exclude or manage human role as much as possible

Day 1 Session B – in ditch NDE (2)

- Continuous Monitoring of Pipeline
  - Structural Health Monitoring approaches
  - Macro monitoring and surveillance vs micro
  - PSM Bow Tie/Swiss Cheese and applying technologies for continuous monitoring where barrier is needed

- Above Grade NDE – measurement from above
  - Current industry work on LSM technologies
  - Alternative to ILI

- Enhanced discrimination of cracks & crack-like features
  - Coincident and complex features
  - Discriminate resident vs propagating (latent/active)
  - Pipe body and welds

- Improve Guided Wave UT
  - Cased crossings

Day 2 Session B – Difficult to Inspect Pipelines
Development Theme 1: Expanding Vehicle Capabilities

- Broader range of diameters and configurations
  - Telescoping diameters
  - Thick wall piping systems
- Longer inspection distances
  - Improved power systems - range factor
  - Lighter weight tools
- Pipe cleaning and debris

Day 2 Session B – Difficult to Inspect Pipelines

Development Theme 2: Expanding Inspection Capabilities

- Expanding the threats that can be detected
  - Most existing capabilities are wall loss related – i.e. MFL
  - Crack detection, denting, and mechanical damage are all areas for development and improved sensing
- Challenging features
  - Long seams
  - Pipe bends
  - Wrinkle bends
  - Construction Error/ non-conforming pipe
- Expansion into coating condition and cathodic protection measurement?

Day 2 Session B Difficult to Inspect Pipelines Other Items & Topics

- Reduce sensor package burden on the tool
- Limited data sets – acceptable threshold, reasonable determination
- Assessment and Prioritization of cast iron pipe
- Reduce encumbrances on operator

Day 2, Session B Difficult to Inspect Pipelines

Emerging Challenge: Technologies to Verify Pipe Material

- Modification of inspection techniques to measure non-traditional features (fingerprints/tell-tales) to provide:
  - Affirmative identification of legacy pipe
  - Demonstration of conformance to specification/standard
- Consideration includes re-examination of existing technology to provide supplemental data
  - Adaptation of available techniques
  - Non-traditional data sets – low field magnetization
- Development of programs, standards, specifications to manage the application of these emerging methods

Day 2 Session C – anomaly assessment

- Pressure Test Design Guidelines
  - Pipe is different, shouldn't hydrotest design be?
  - Reliability
  - Consider other industry sources
  - Validation sample for ILI
  - Destructive impacts of pressure testing – above yield, dormant features, NDE measurements

- Pressure Test Leak Detection
  - Sensors, tracer,
  - tie-in with internal sensor

- Vintage Pipe Material Database
  - Min, max available values
  - YS for specific manufacturing – define range (see min/max above)