May 15, 2013

MEETING PRESENTATIONS

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Underground Pipe and Tank NDE Technology Update

Steve Kenefick
Senior Project Manager

Mike Quarry
Project Manager

NRC/Industry Underground Piping and Tanks meeting

April 25th, 2013

White Flint, MD

Overview

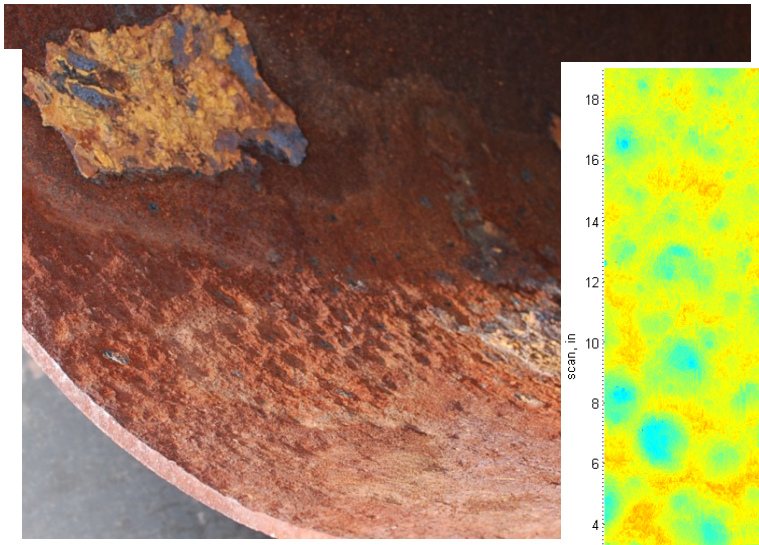
- Strong industry commitment to buried/underground pipe and tank NDE research continues
- NDE technology successes
- Industry guided wave technology progress
- Guided wave going forward
- Recent EPRI reports
- Action item

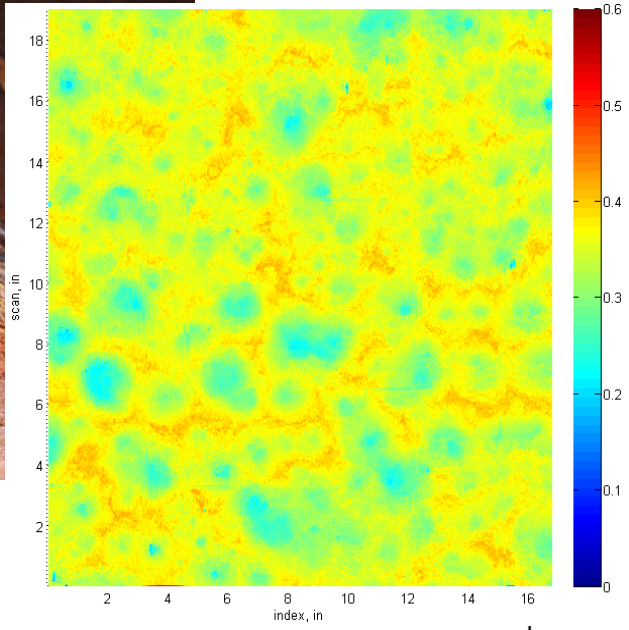
EPRI Buried/underground and Tank NDE Program

- **Industry continues to make a significant commitment to buried/underground pipe and tank NDE through EPRI**
  - Support industry in implementing NDE technology
  - Benchmark existing NDE technology capabilities
  - Develop/improve NDE technology
  - Provide resources such as mock-ups and information to service providers to test and refine NDE technologies and procedures
  - Identify NDE technology that can be transferred to nuclear
  - Develop high density polyethylene (HDPE) NDE technology
  - Further develop guided wave technology
  - Develop/assess structural health monitoring technology

NDE Technology: Ultrasonic Phased Array Technology

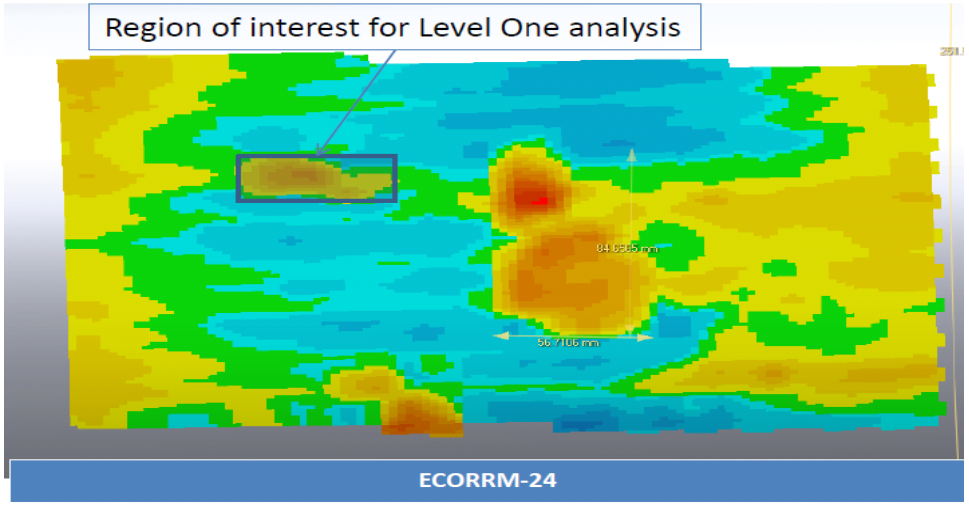
- Provides increased sensitivity to corrosion, full coverage, imaged results, and permanent records
- Technology was identified, assessed, and reported on in a number of presentations and publications by EPRI
- Success – Inspection vendors and plants are starting to use





3D Optical Scanner Technology

- Technology developed in conjunction with pipeline industry
- Offers rapid characterization of accessible corrosion
- Success – technology now commercially available



Guided Wave Technology Progress

Success – Industry has improved the implementation of guided wave technology

- Buried Pipe Guided Wave Examination Reference Document (EPRI Report 1019115)
- Well attended 3-day EPRI Guided Wave Training Seminars for utility personnel
- NDE industry developing guided wave personnel qualification Codes and Standards (EPRI engaged)
- Exchange of guided wave OE at BPIG

Guided Wave Technology Progress

Commercial guided wave manufacturers have released improved software and hardware

- Improved features: focusing, unrolled pipe display, frequency response analysis

Guided Wave Technology Progress

EPRI empirical and virtual research results have led to better understanding of guided wave capabilities

- Detection of various types of flaws
  - Dish-type of flaws, flat-bottom holes, clustered pits, notches
- Various coatings and backfills
  - Coal tar enamel, coal tar epoxy, tapewraps, fusion-bonded epoxy, butyl rubber
  - Clay, pea gravel, cement
- General corrosion and surface roughness
- Tuberculation
- Temperature
- Wall penetrations, grouting

Guided Wave Mockups

Current Research – Develop Criteria to Credit Guided Wave as a Direct Examination

Objective – Develop criteria to credit guided wave as a direct examination for detection

- Discontinuity target size is known and detectable
- Actual guided wave data quality meets established performance criteria such as:
  - Adequate reference features are present
  - Signal-to-noise requirements are met
  - Minimum data quality requirements are achieved
  - Appropriate pipe configurations

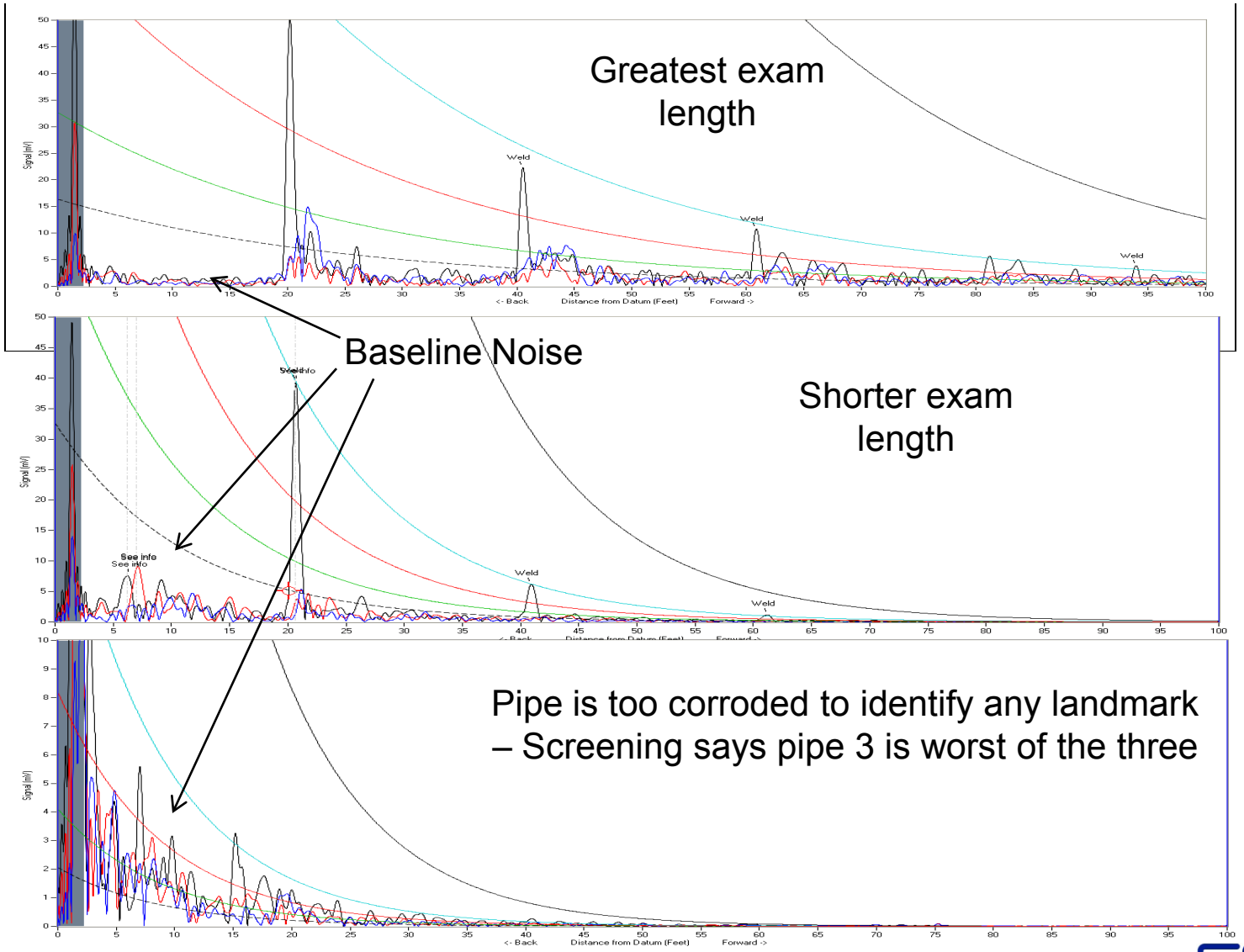
24” Diameter Pipe Mockup Several Discontinuities

Guided Wave Data from a Pritec Coated Pipe with Different Backfills Show Different Decay Rates

Native clay

Pea Gravel

Attenuation and Noise Increases with Surface Roughness (data from field removed pipe)



Pipe 1

Least severe corrosion

Pipe 2

Intermediate severe corrosion

Pipe 3

Most severe corrosion

Developing Appropriate Direct Examination Criteria

- Target flaw size must be identified based on the intent of the examination
- Performance indicator criteria
  - Minimum signal-to-noise ratio for landmark calibration
  - Minimum signal-to-noise ratio for target flaw
  - Required frequency sweeping and response analysis
  - Quantitative focusing characteristics
  - Quantitative requirement for call line to baseline noise level for length of credit
  - Identification of dead zone

Guided Wave Structural Health Monitoring to Reduce Excavations

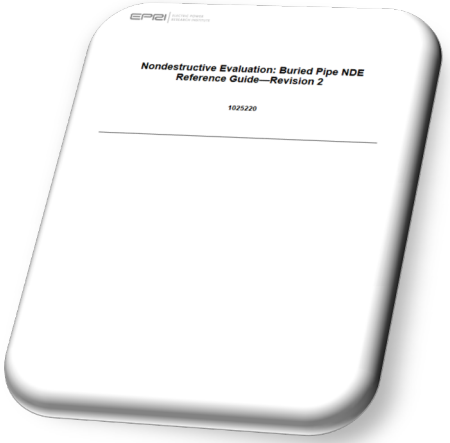
- Permanently installed guided wave sensors have been used to non-invasively examine piping over time
  - Monitor changes over time
  - Only initial excavation needed
  - Processing out changes in signals simplify data interpretation
- EPRI plans to:
  - Assess capabilities of current technology for various conditions, including coatings, backfills, temperature, moisture, flow through pipe, and seasons
  - Enable vendors to develop and refine their analysis software

Permanently Installed Sensors

EPRI Underground Pipe and Tank NDE Reports Published in 2012

- Nondestructive Evaluation: Buried Pipe Nondestructive Evaluation Reference Guide—Revision 2 (1025220)
- Nondestructive Evaluation: Buried Pipe NDE Technology Assessment and Development Interim Report (1025219)
- Inspection Methods for Tanks and Containment Liners (1025215)
- Buried Pipe Direct Examinations Through Coatings (1025228)
- Guided Wave Analysis Tools Update (1025212)
- Buried Pipe Structural Health Monitoring Sensitivity Studies (1025213)
- Nondestructive Evaluation: Buried Pipe In-Line NDE Depth Sizing Procedure (1025231)

Industry Support and Guidance



- Nondestructive Evaluation: Buried Pipe Nondestructive Evaluation Reference Guide—Revision 2 (1025220)
  - Basic theory
  - Technology selection guidance and limitations
  - Overview of techniques, equipment, and applications
  - Summary of remote delivery technology

At the request of the NRC, EPRI has decided to put this report in the public domain

Together…Shaping the Future of Electricity