EPRI | ELECTRIC POWER RESEARCH INSTITUTE

UPT NDE Technology Update

Steve Kenefick
Senior Project Manager

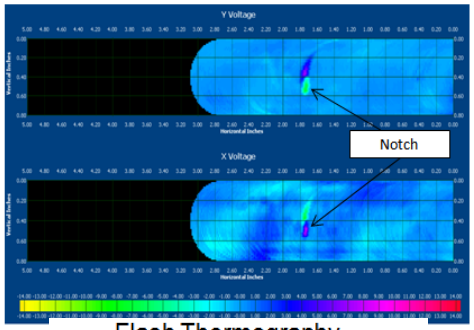
NRC/Industry UPT Meeting

October 9th, 2013

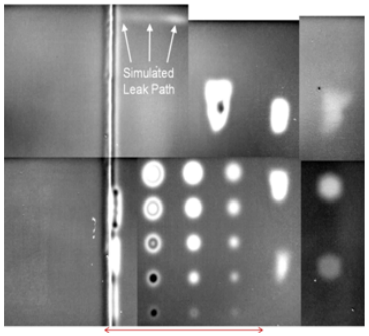
White Flint, MD

UPT NDE Technology Update Overview

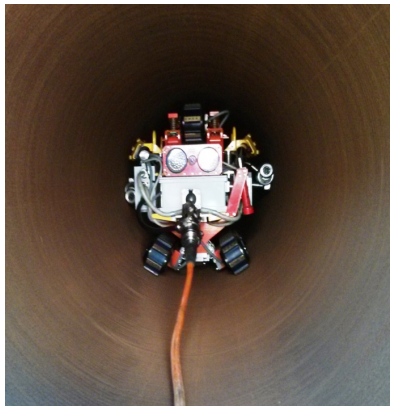
Eddy Current Rotational Scanner

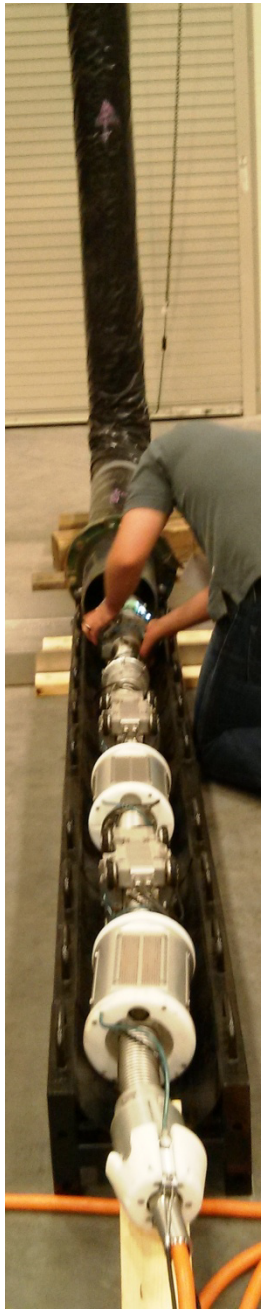


Flash Thermography



- Buried pipe NDE technology assessment update
- Tank NDE update
- Guided wave as a direct examination
- 2014 UPT NDE research
- UPT EPRI NDE reports

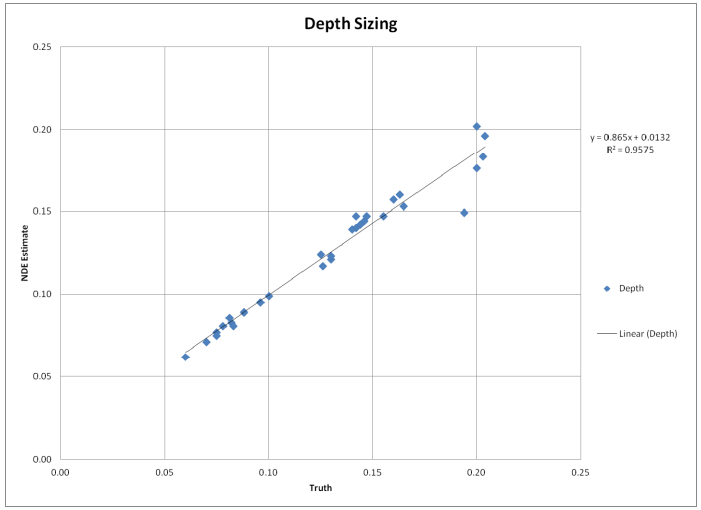




EPRI ELECTRIC POWER RESEARCH INSTITUTE

EPRI Assessment and Development of Buried Pipe NDE Technology Update

- Benchmark buried pipe NDE capabilities
  - Mock-ups to assess technology
  - Interim report published 3rd qt 2012
- Identify and develop new NDE technologies
- Provide resources for vendors to evaluate and improve their procedures
- Provide utility support in implementing technology
- Results to be published in December in *Nondestructive Evaluation: Assessment and Development of Buried Pipe NDE Technology Report* (3002000463)

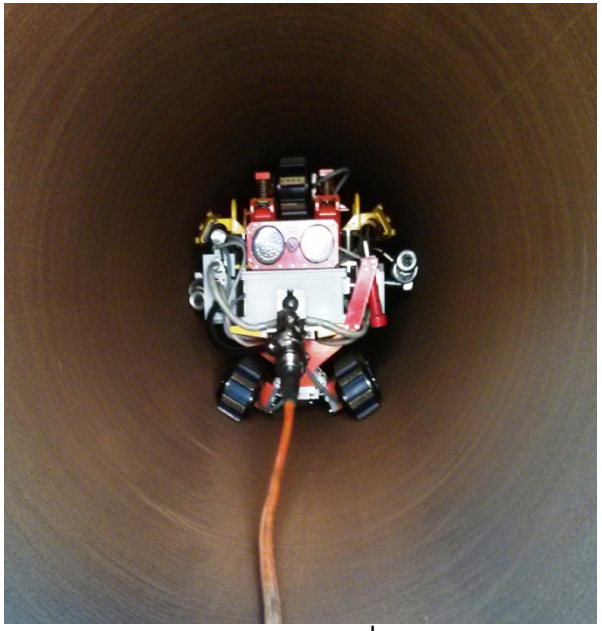


EPRI ELECTRIC POWER RESEARCH INSTITUTE

Recent NDE Technology Assessments

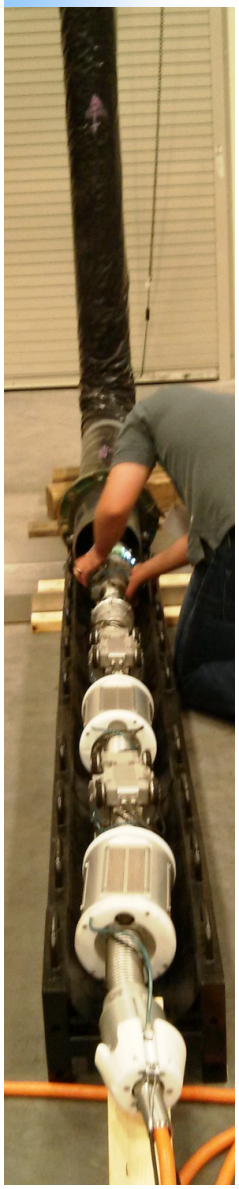
- Ultrasonic robotics – Electromagnetic Acoustic Transducer (EMAT)
  - Couplant not needed
  - Volumetric exam of pipe material can be made through some coatings
  - Less sensitive to contact surface conditions
  - Reduced surface preparation*
  - Reduced signal resolution and signal-to-noise ratios*
- High resolution cameras and 2 EMAT sensors on rotating head
- Assessment conducted on 24-inch diameter mock-ups

* Compared to contact piezoelectric



EPRI ELECTRIC POWER RESEARCH INSTITUTE

Recent NDE Technology Assessments



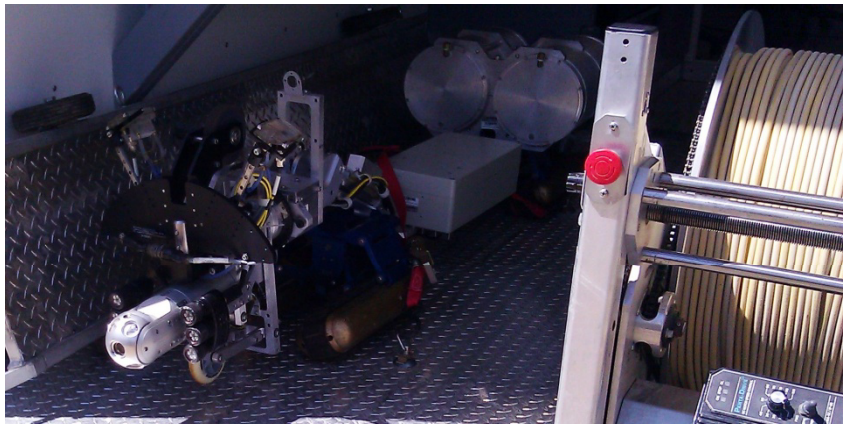
- Robotic driven ultrasonic in-line technology
  - Rotating head with 8 zero-degree transducers and high resolution cameras
  - Couplant fed to transducers (bubbler system)
  - Real time view of ultrasonic data and camera images
  - Storage of data allows for subsequent data analysis
- 8-inch mock-up with 5 elbows and many discontinuities sizes and types

Recent NDE Technology Assessments

- In-line Remote Field Eddy Current (RFT)
  - Does not require direct access to pipe surface
  - Potential to measure wall thickness through coatings, linings, concrete, deposits, tubercles, sand, and mud
  - Detection of anomalies such as general thinning and pits
  - Provides equal sensitivity to external and internal deposits
  - Tethered or flow through
- Assessment conducted on 4-inch diameter mock-ups

Recent NDE Technology Assessments

- Circumferential Lamb-wave In-line Technology
  - Transducers are moved along length of pipe
    - Cleaning only needed at scanning surface of pipe
  - High resolution cameras
  - Wall loss within sound beam causes a change to wave properties
  - Signal processing used to identify and display changes
  - Can detect internal and external corrosion
- Assessment – 24-inch diameter mock-ups

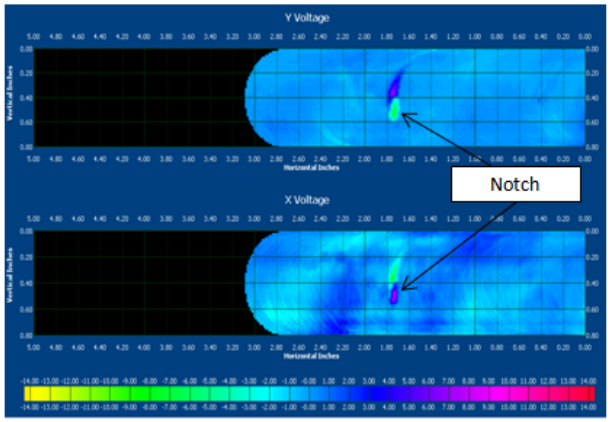


EPRI ELECTRIC POWER RESEARCH INSTITUTE

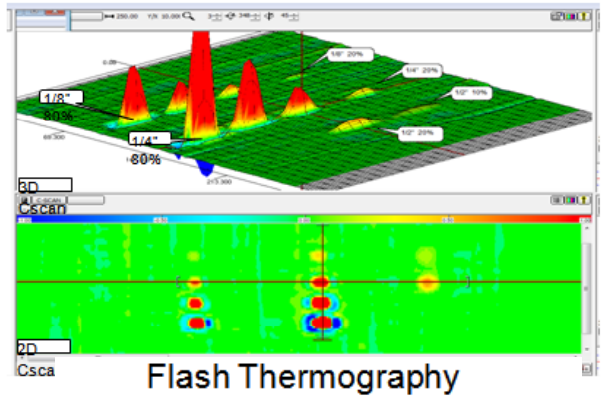
Tank NDE Update

- NDE experiments completed
  - Infrared thermography
  - Eddy current rotational scanner
  - Alternating current field measurement (ACFM)
  - Eddy current array coils
- Guided wave monitoring technology
- Crawlers for tanks containing product
- Leveraging PRCI R&D results
- *NDE for Tanks and Containment Liners* (Report 3002000462 to be published in Dec. 2013)

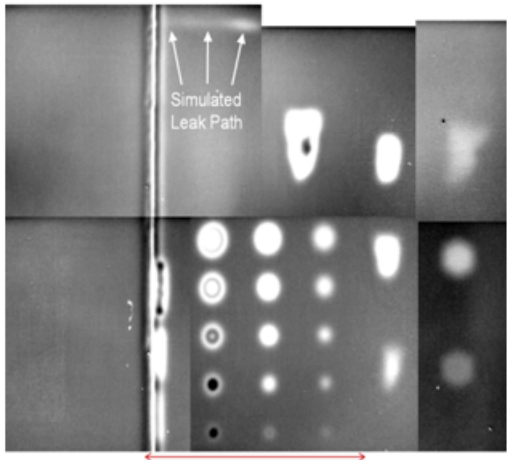
Eddy Current Rotational Scanner



Eddy Current Arrays



Flash Thermography



EPRI ELECTRIC POWER RESEARCH INSTITUTE

Criteria to Credit Guided Wave as a Direct Examination

- Objective – Develop criteria to credit guided wave as a direct examination
- Framework presented at last NRC public meeting (April, 2013)
  - Discontinuity target size is known and detectable
  - Guided wave data quality meets performance criteria
- Action
  - EPRI considering public release of *Buried Pipe Guided Wave Examination Reference Document (*1019115)
- Research progress continues and will be published Dec, 2013
  - *Guidelines for Obtaining Credit for Buried Pipe Guided Wave Examinations* (3002000468)
- Going forward

2014 UPT NDE Research

Significant industry commitment to UPT NDE development through EPRI continues

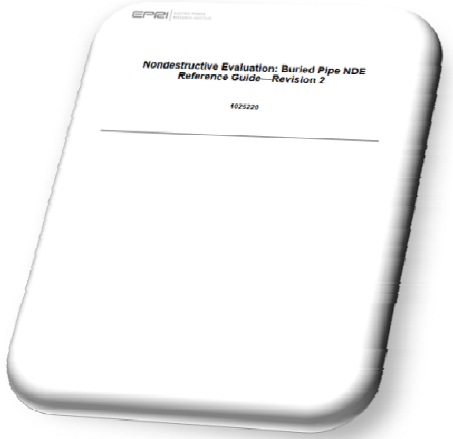
- Assessment & development of buried pipe NDE technology
  - Benchmark existing NDE technology capabilities
  - Provide resources to service providers to test and refine NDE technologies and procedures
- Support industry in implementing NDE technology
- Guided wave
  - Data analysis development
  - Structural health monitoring
  - Direct examination credit
- Assessment and Evaluation of NDE Technologies for Tanks (tentative)
- Technique development for HDPE pipe butt fusion weld strength eval.
- Leak detection technology development

2014 UPT NDE Research (cont.)

- EPRI engaged with Pipeline Research Council International (PRCI) NDE technology development (>$2.5M)
  - Performance and application of various NDE technology
  - Integrated pipeline monitoring and cleaning tool
  - Meandering winding Magnetometer (MWM) crack depth measurement
  - Small leak detection for liquid pipelines
  - Inspection of composite repairs
  - Performance testing of large standoff magnetometer tools
  - ILI technology improvements
  - Access to 500 field removed samples

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 approved placing this report in the public domain

Buried / Underground Piping NDE Reports

Nondestructive Evaluation: Buried Pipe Nondestructive Evaluation Reference Guide—Revision 2 (1025220)

Nondestructive Evaluation: Buried Pipe NDE Reference Guide—Revision 2, Addendum 1 (3002000447) December, 2013

Nondestructive Evaluation: Assessment and Development of Buried Pipe NDE Technology (3002000463) December, 2013

Nondestructive Evaluation: Buried Pipe NDE Technology Assessment and Development Interim Report (1025219)

Inspection Methodologies for Buried Pipes and Tanks (1021561)

Buried Pipe Direct Examinations Through Coatings (1025228)

Nondestructive Evaluation: Buried Pipe In-Line NDE Depth Sizing Procedure (1025231)

Intermediate Diameter Buried Piping Instrumented Vehicle--Evaluation (1022926)

Remote Field Technology Assessment for Piping Inspection Including Buried and Limited Access Components (1021153)

Catawba Field Trial of EPRI's Large Diameter Buried Pipe Instrumented Vehicle (1016676)

Guided Wave Piping Reports

- Buried Pipe Guided Wave Examination Reference Document (1019115)
- Guided Wave Analysis Tools for Buried Pipe (3002000466) December, 2013
- Guidelines for Obtaining Credit for Buried Pipe Guided Wave Examinations (3002000468) December, 2013
- Nondestructive Evaluation: Guided Wave Analysis Tools (1025212)
- Nondestructive Evaluation: Guided Wave Status Report (1022929)
- Nondestructive Evaluation: Further Developments of Guided Wave Examination Application 2009 Status Report (1019116)
- Nondestructive Evaluation: Further Developments of Guided Wave Examination Application (1016675)
- Nondestructive Evaluation: Buried Pipe Structural Health Monitoring (1025213)

Underground Tank NDE Reports

NDE for Tanks and Containment Liners (3002000462) December, 2013

Inspection Methods for Tanks and Containment Liners (1025215)

Inspection Methodologies for Buried Pipes and Tanks (1021561)

Together…Shaping the Future of Electricity