EPRI | ELECTRIC POWER RESEARCH INSTITUTE

UPT NDE Technology Update

Steve Kenefick
NDE Principal Project Manager

NRC/Industry UPT Meeting
June 11, 2014
White Flint, MD

UPTI NDE Technology Update Overview

- EPRI UPTI Program Overview
- Tank NDE update
- Pipe NDE technology assessment update

2014 EPRI UPT NDE Technology Projects

EPRI has invested significantly in UPT NDE technology since 2007 and continues in 2104

- Ten 2014 NDE UPT projects
  - Several projects continuing from 2013
  - Two important projects scheduled to sunset in 2013 were extended into 2014
  - Five additional EPRI NDE projects bring value to UPT

EPRI ELECTRIC POWER RESEARCH INSTITUTE

2014 EPRI UPT NDE Research Projects

- Assessment and Evaluation of NDE for Tanks and Containment Liners (extended into 2014)
- Assessment and Development of Buried Pipe NDE Technology (extended into 2014)
- Criteria to credit guided wave as a direct examination (continuation from 2013)
- Revision to the Buried Pipe NDE Reference Guide
  - Additional technologies and operating experience will be added
- Guided Wave Structural Health Monitoring (continuation from 2013)

2014 EPRI UPT NDE Research

- Leveraging other industry resources – EPRI engaged with PRCI NDE technology development (>$2.5M)
- Capabilities of NDE for quantification of real corrosion in buried piping (continuation from 2013)
- Investigation of new techniques for permanently mounted guided wave sensors (continuation from 2013)
- Technique development for HDPE pipe butt fusion weld strength evaluation (continuation from 2013)
- Examination through coatings (continuation from 2013)
  - Quantifying NDE capabilities through various coatings

Guided Wave Structural Health Monitoring

Purpose

- Install during excavation
- Data can be collected remotely
- Monitor for changes over time allows for detection of small wall loss
- Project will:
  - Include various GW systems
  - Assess the effects of variables that can affect guided waves
- Co-funded by PRCI
  - Engagement with major oil company and National Lab on new technology

Criteria to Apply Guided Wave as a Direct Exam

- Research results were published in December, 2013
  - *Guidelines for Obtaining Credit for Buried Pipe Guided Wave Examinations* (3002000468)
- Industry review of performance criteria and configuration restrictions scheduled for first week of July, 2014
  - Need to establish industry consensus
- Subsequently, the framework with criteria and guidelines will be submitted to NRC

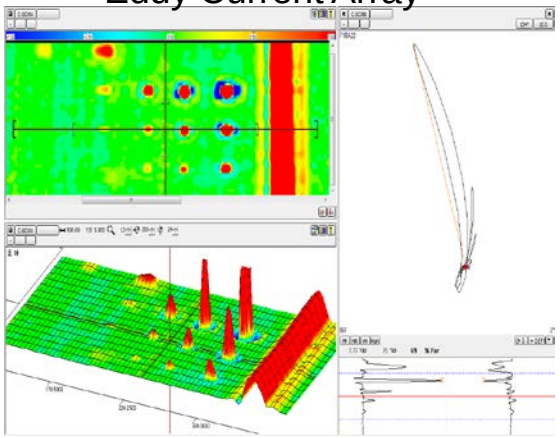
UPT NDE Technology Update Overview

- EPRI UPT Program Overview
- Tank NDE update
- Pipe NDE technology assessment update

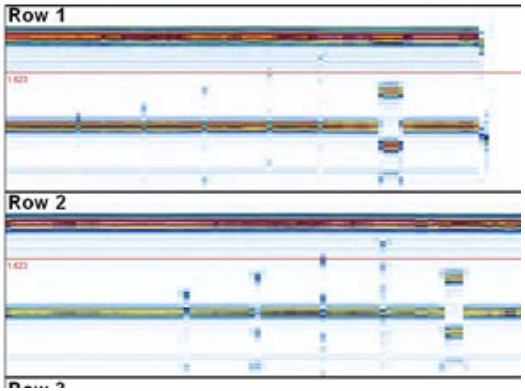
Assessment and Evaluation of NDE for Tanks and Containment Liners (2014-16)

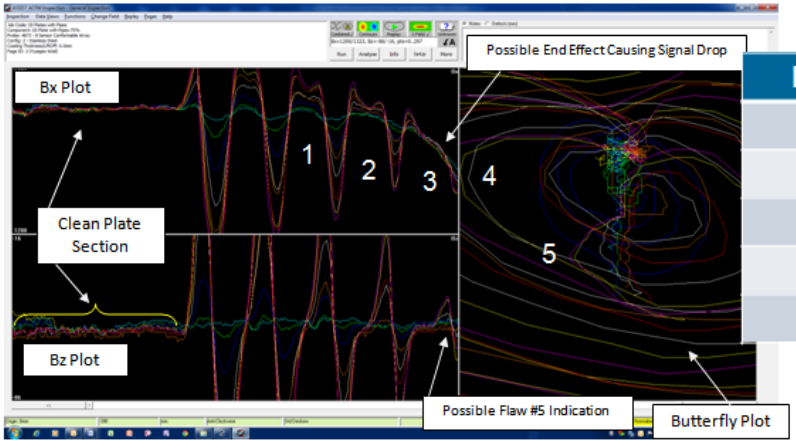
- Purpose
  - Assessment tank NDE technologies
  - Assess tank NDE robotics
- Leveraging PRCI R&D results
- *NDE for Tanks and Containment Liners (*Report 3002000462 published in Dec. 2013)

Eddy Current Array



Ultrasonic Phased Array



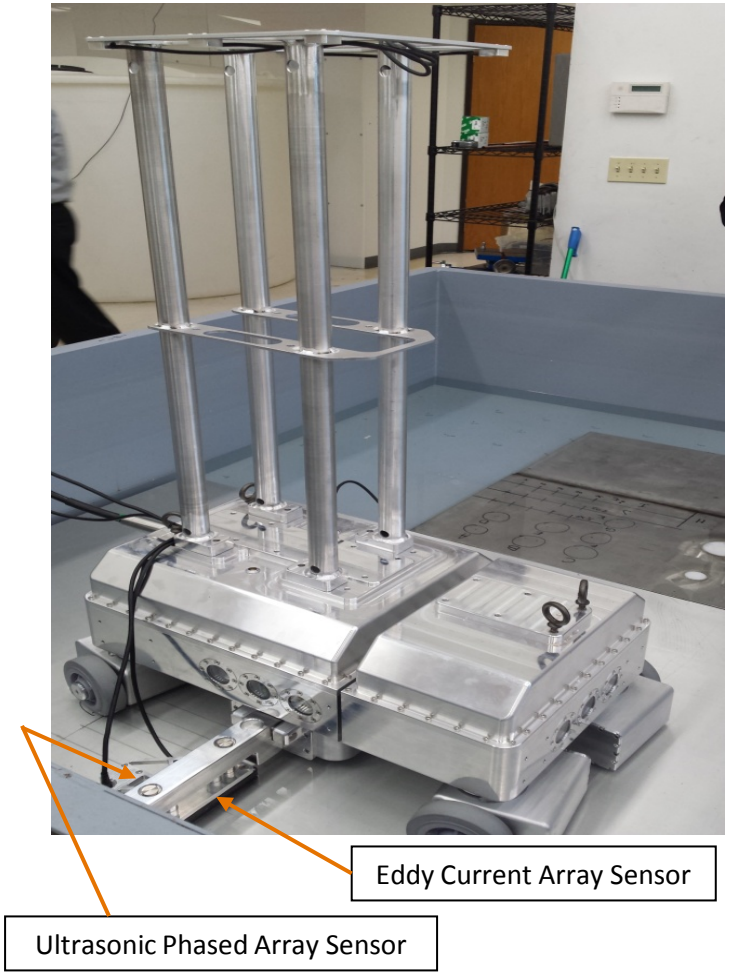


Flaw	Diameter
1	25mm
2	20mm
3	15mm
4	10mm
5	5mm

EPRI ELECTRIC POWER RESEARCH INSTITUTE

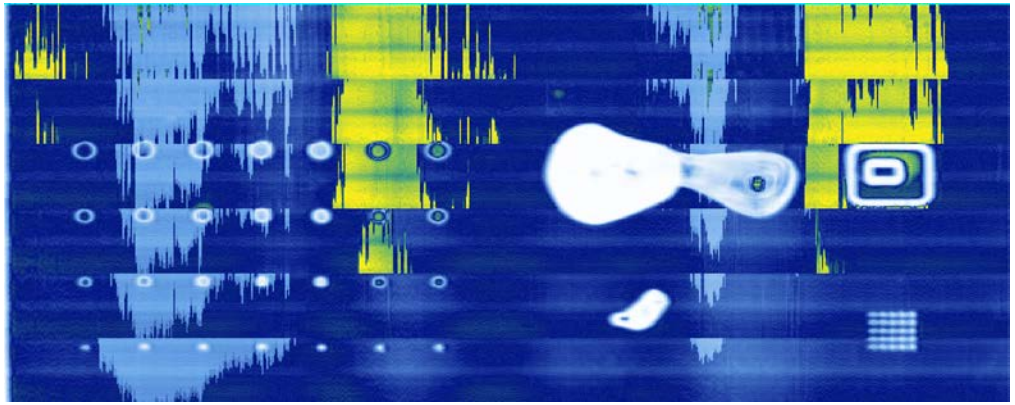
Recent Tank NDE Activities

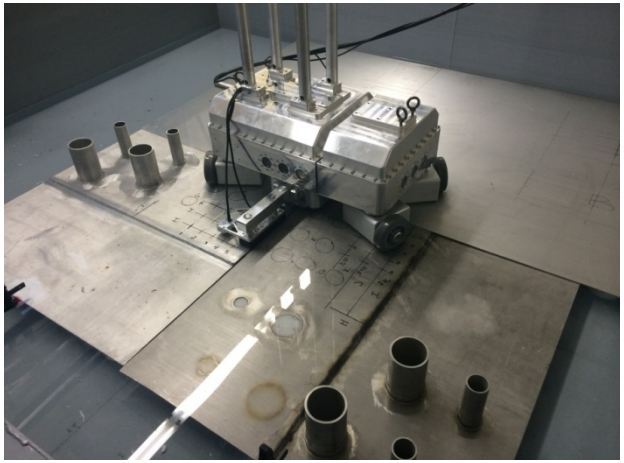
- Demonstration of an inspection robot in a tank mock-up
  - Robot submersed in water
  - Eddy current array and ultrasonic phased array sensors
- A further demonstration and site inspections planned for Fall 2014
  - Stainless steel CST tank
  - Eddy current array and ultrasonic phased array sensors

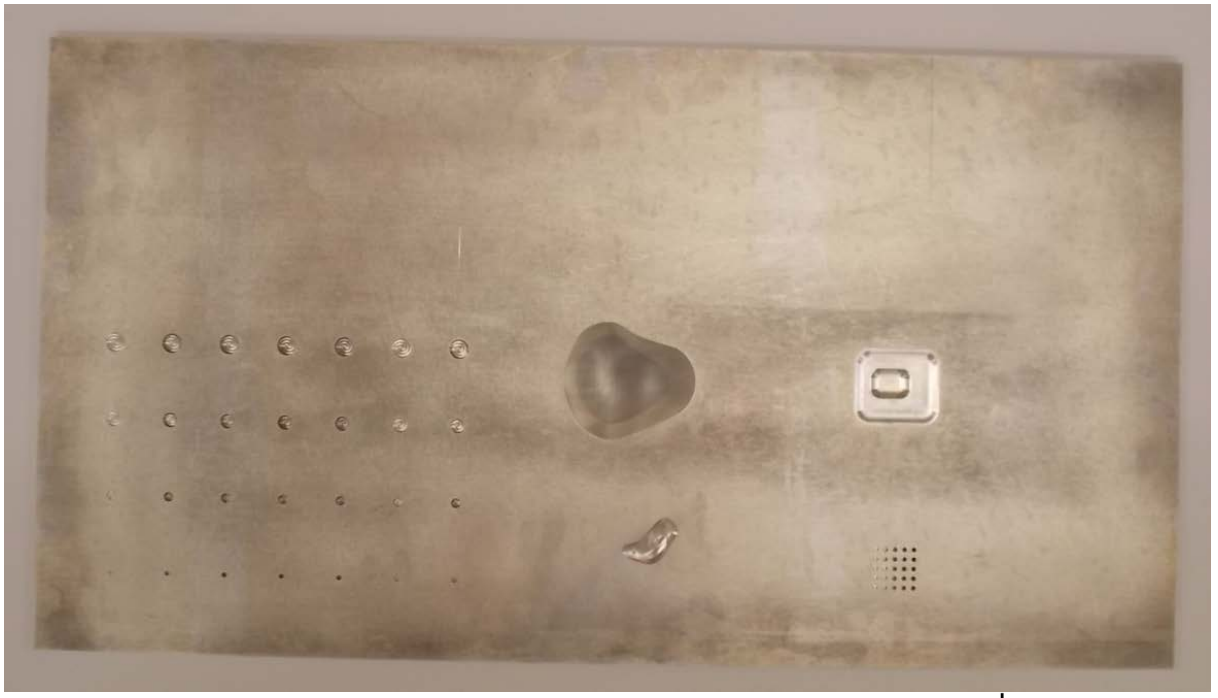


Recent Tank NDE Activities

- Ultrasonic phased array results obtained on EPRI mock-up

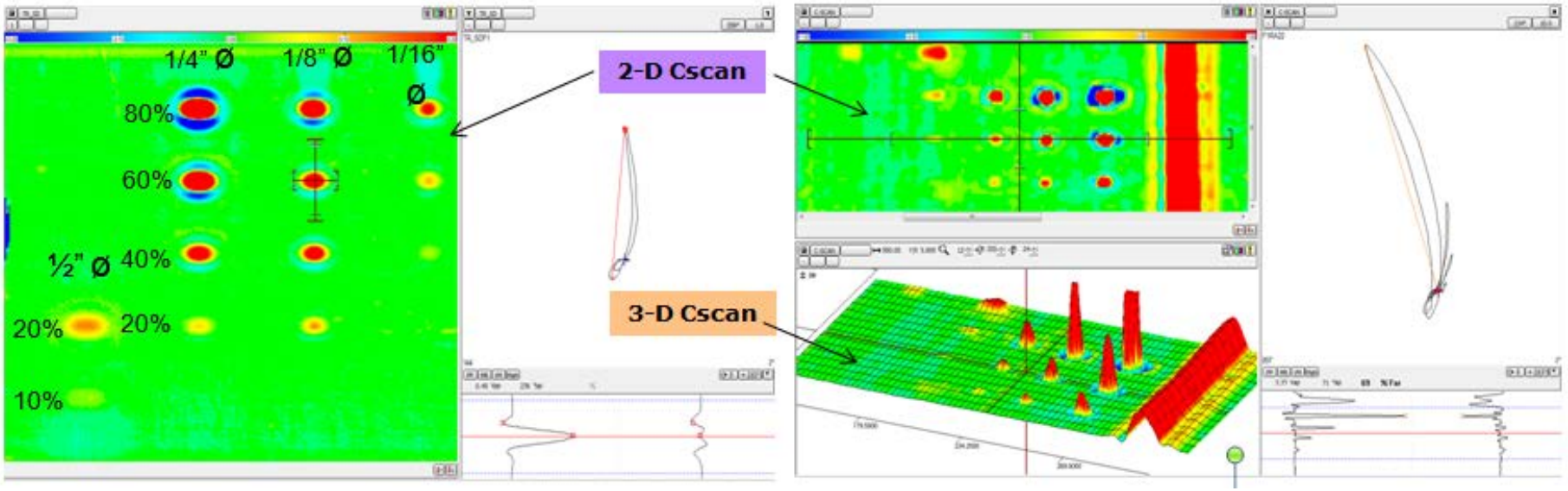


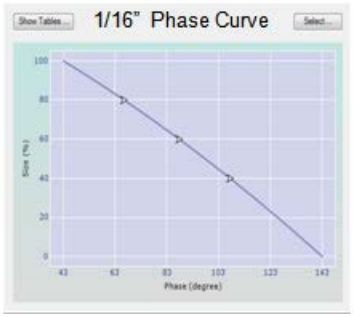


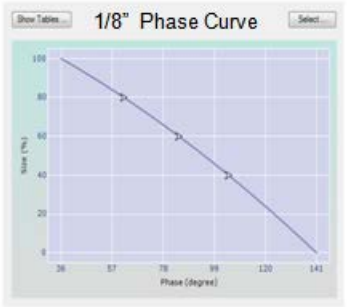


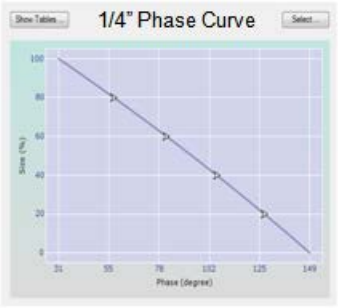
Recent Tank NDE Activities

Eddy current array sensor operated at 800Hz (¼” Aluminum plate)









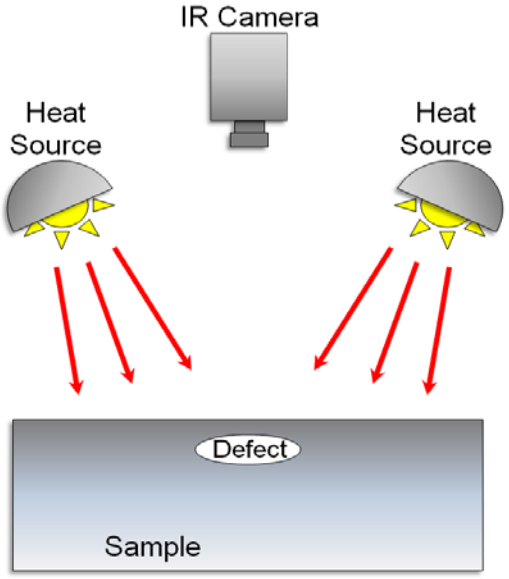
EPRI ELECTRIC POWER RESEARCH INSTITUTE

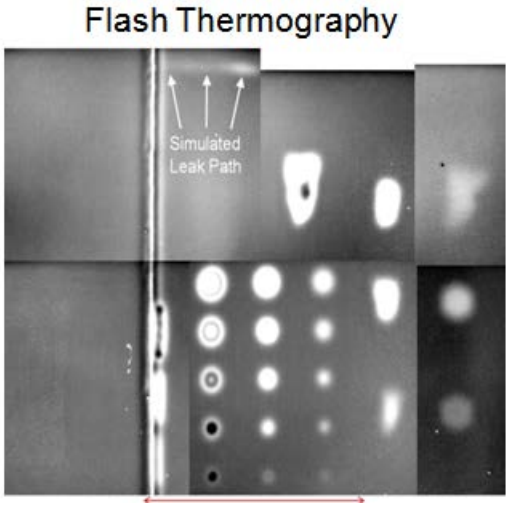
Tank NDE Update

- Thermography experiments performed on fabricated plate mock-ups

- Feasibility study using the short-range guided wave testing
  - Electromagnetic Acoustic Transducers (EMATs) sensors
  - Carbon steel, stainless steel and aluminum plate mock-ups with fabricated flaws and service induced pits

- EPRI held the “Symposium on Concrete Structures, Liner Barriers and Tanks”





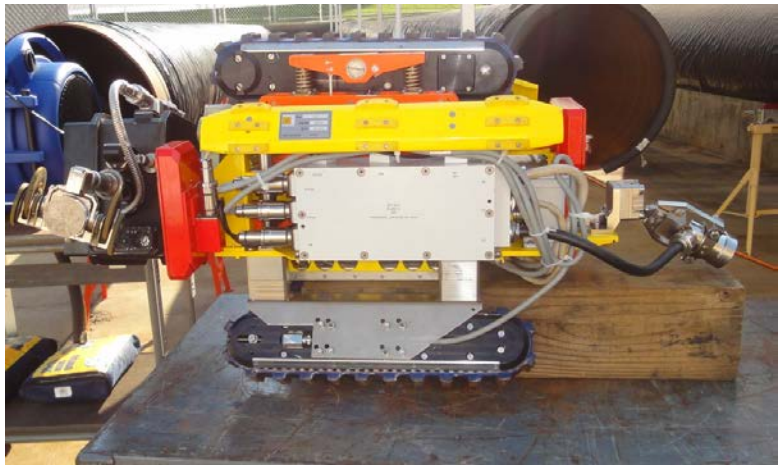
UPT NDE Technology Update Overview

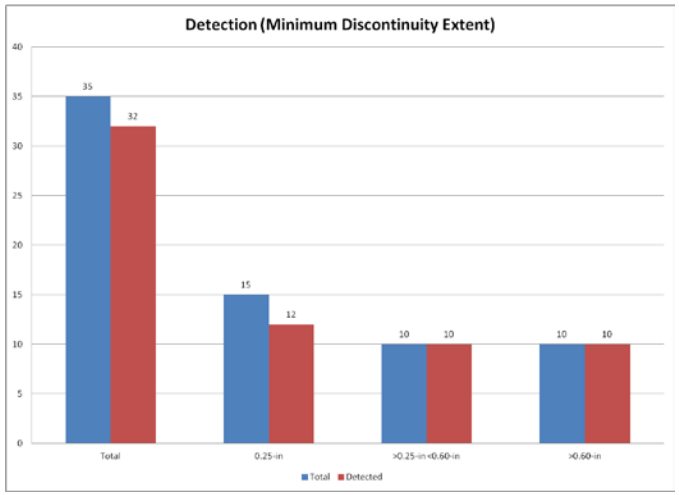
- EPRI UPT Program Overview
- Tank NDE update
- Pipe NDE technology assessment update

Assessment and Development of Buried Pipe NDE Technology (2014-16)

Purpose

- Benchmark buried pipe NDE capabilities
- Provide resources for vendors to tweak procedures
- Provide utility support in implementing technology
- Identify new NDE technologies

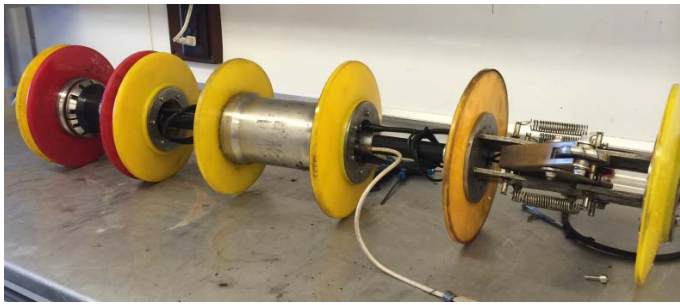




EPRI ELECTRIC POWER RESEARCH INSTITUTE

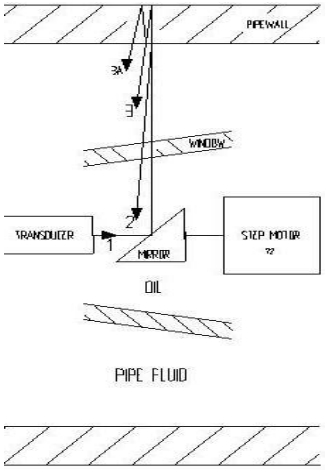
Recent Piping Technology Assessment

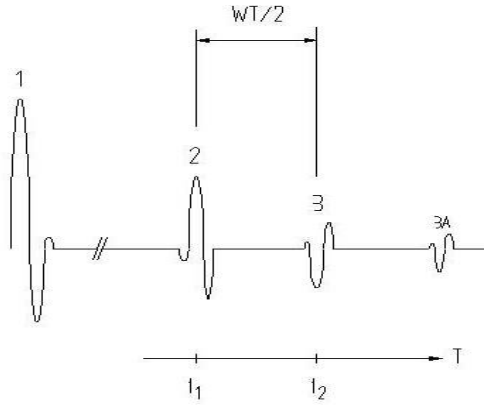
- ILI device propelled through the pipe with the flow of fluid
  - Capable of bi-directional tool
- Assessment conducted on EPRI's 8-in diameter 60-ft long mock-up
  - 6 elbows
  - 1-diameter bend elbow
  - Maneuvered through mock-up without issue
- Results to be published in upcoming report



Recent Piping Technology Assessment

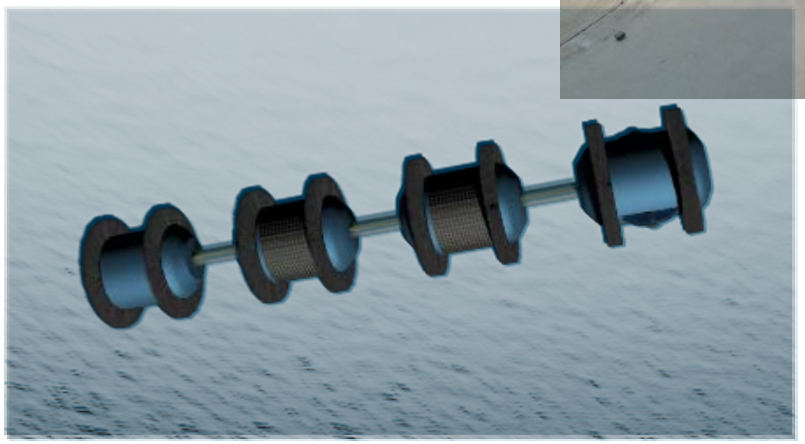
- Ultrasonic flow through in-line inspection technology
  - Single transducer with a rotating mirror
  - Onboard pulser, receiver, digitizer, data storage
    - Data stored on-board
    - Real time view of ultrasonic data can be obtained
- Technology has been used at a US nuclear plant





Assessed NDE Technologies Used in the Field

- Inline flow through ultrasonics
- Ultrasonic robotics – Electromagnetic Acoustic Transducer (EMAT)
- In-line Remote Field Eddy Current (RFT)
- Phased array ultrasonics



EPRI ELECTRIC POWER RESEARCH INSTITUTE

EPRI Buried and Underground Pipe NDE Reports (Red – denotes results published in 2013)

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

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

✓Nondestructive Evaluation: Assessment and Development of Buried Pipe NDE Technology (3002000463)

- Replaces interim report 1025219

✓Buried Pipe Direct Examinations Through Coatings (1025228)

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

EPRI Buried and Underground Pipe NDE Reports

- ✓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)
- ✓Buried Pipe Guided Wave Examination Reference Document (1019115)
- ✓Guided Wave Analysis Tools for Buried Pipe (3002000466)
- ✓Guidelines for Obtaining Credit for Buried Pipe Guided Wave Examinations (3002000468)

EPRI Buried and Underground Pipe NDE Reports

- ✓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)

EPRI Tank and NDPE NDE Reports

Tank NDE Deliverables

- ✓Nondestructive Evaluation: NDE for Tanks and Containment Liners (3002000462)
- ✓Inspection Methods for Tanks and Containment Liners (1025215)
- ✓Inspection Methodologies for Buried Pipes and Tanks (1021561)

High Density Polyethylene (HDPE) NDE Technology

- ✓Nondestructive Evaluation: High-Density Polyethylene NDE Technology (3002000439)

Together…Shaping the Future of Electricity