Demonstration Activities of Buried Piping NDE Technologies at EPRI

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EPRI

4th International CANDU In-Service Inspection Workshop

Toronto, Ontario
Field Removed samples for assessment of buried pipe inspection technologies

- Field removed samples are/have been obtained
Initial Revision (November 2009)

- Formal industry roles and responsibilities
- Provide “reasonable assurance” of structural and leakage integrity of all buried piping with special emphasis on piping that contains radioactive materials.

Schedule

- Procedures and Oversight – Industry completed
- Risk Ranking – Industry completed
- Inspection Plan – Industry completed
- Plan Implementation
  - Start by – June 30, 2012
  - Buried piping containing radioactive material – June 30, 2013
- Asset Management Plan – December 31, 2013
December 2010

NEI 09-14 Revision 1 “Guideline for the Management of Underground Piping and Tank Integrity”
  – Incorporates the revised NSIAC “Underground Piping and Tank Integrity Initiative”
  – Extensive revision

NRC Issues revision 2 of the GALL (license renewal)
  – Significant additions to buried pipe inspection recommendations
  – More prescriptive requirements
Challenges - Piping is often inaccessible

• Difficult to access pipe – buried, pipe chases, buildings, go through walls, under water, etc.
• Often need to have water or other product in the pipe or flowing through it
• Pipes are coated or insulated
• Pipes are often nested close to one another and have a high density (“spaghetti bowl” of piping)
• Pipes may have tubercles, mud, scale, etc, causing rough and dirty surfaces
• No designed launchers/retrievers
• Lots of bends, elbows, vertical sections, tees, etc.
Occlusions – internal corrosion deposits
Types of Corrosion common in piping

- General corrosion
- Clustered pitting
- Galvanic corrosion
- Crevice Corrosion
- Microbiologically Influenced Corrosion (MIC)
- Corrosion under Insulation (CUI)
- Erosion
# Potential NDE Technologies for Buried Pipe

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**In-line Delivery Methods**
- Robotic Crawlers
- Flow through
- Pull through
Benchmark and develop NDE capabilities

- Identify capabilities and limitations
- Provide utility support in implementing technology
External Remote-Field technology

• Localized remote field technology (RFT) assessment in process
Mockup with multiple bends and verticals to test delivery systems

- Construction of 60-ft long 8-in diameter mock-up assess NDE and delivery tool
Internal Robotic System Using Ultrasonics
Internal Ultrasonic Tool

Free swimming internal ultrasonic

• Used in other industries
• Navigates Short Radius - 1D - 180° bends
• Transducer array provides 100% coverage
• On-board data collection
• Detect internal and external thinning
Recent Internal Ultrasonic Tool Assessment

Assessment Conducted on 60-ft long 8-in Diameter EPRI Mock-up

- Examined in <1 minute
- Full coverage of straight pipe sections
- Identified inside and outside surface connected discontinuities
- Working to facilitate pilot of technology
Ultrasonic Phased Array Technology

Phased array probes

• Rapid Scanning
  – 100% coverage over probe width
  – Scan speeds up to 16 in² / second
• Greater sensitivity to sharp flaws such as MIC
• Improved depth and extent sizing
• Imaging capabilities
• Permanent data storage
Ultrasonic Phased Array Technology

- C-scan (Top View) image of holes
  - Twelve 0.188-in diameter holes
  - 0.375-in center-to-center
  - Patch 0.750-in by 1.125-in
Ultrasonic Phased Array Technology

2-in by 1.75-in

Outer Surface

Inner Surface

Side View

Top View
In-line Examination of Intermediate Diameter Piping

- EPRI Robot
- Guide Wire Propulsion
- 108 Sensors for Pitting Resolution
- Detectors Position Stabilized for Data Quality

60ft Cement Lined Mockup
3 Elbows – 1 Riser
12 Implanted Defects
Assessment and Development of Buried Pipe NDE Technology (2011-13)

Multiple assessments are planned with multiple technologies for 2012:

– Internal EMAT ultrasonic robotic device
– Internal robot with saturated low frequency eddy current
– Internal remote field testing RFT
– Internal magnetic flux leakage
Buried Pipe will likely require many NDE technologies

- No “silver bullet”
- Will require a toolbox of techniques
- Many challenges, variables, obstacles, etc. will make technology selection important

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