Synergies between GWT, RFT and PAUT Inspection Techniques for Piping Defects in a CANDU Nuclear Environment - June 2015

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Outline

1. OPG’s Piping & Inspection Requirements
2. General Piping Degradation Mechanisms
3. Inspection Solutions
4. Example 1: Buried Piping CUI/SCC
5. Example 2: Piping Screening: GWT/PAUT
6. Example 3: PAUT and PAUT Screening
7. Example 4: Reverse Engineering
8. Conclusions & Acknowledgments
OPG’s Piping & IMS Inspections

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General Piping Degradation Forms

- General Corrosion
- SCC
- Pitting
- Welds
- SSC
- Deposit
- Blister
- Mesa Corrosion
- Erosion Corrosion
- HIC

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Solution Comparisons

No “Silver Bullet”

Resolution/Capability

COST/Complexity

High Resolution ILI UT
High Resolution Robotics EMAT/MFL/UT
Remote Field Electromagnetic – RFT, Local PAUT
Acoustic/Bd-band Electromagnetic, Guided Wave UT (Screening), PAUT Wheel-probe (Screening)
Internal Visual & Surface Methods – Visual Rovver, PT, MPI
Pressure Test + Analytical Disposition
Analytical Disposition

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Example 1: Steam line – Problem Statement

- Leaks (CUI, Pitting & SCC) from clean water steam lines destined for discharge to lake
- Carbon Steel and 304 Stainless Steel at different locations in system

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Buried Steam line – Problem Statement

NPS 6 Buried Steam line (Corrosion Under Insulation- CUI, Pitting, Stress Corrosion Cracking -SCC)

IMS Rover

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Remote Field Testing: buried pipe technologies

RFT Tooling

- Pitting/general wall loss/OD/ID
- accurate ~ +/- 15\%t
- Occluded or dirty pipe ID-Ok
- No flooding, no launcher or receivers, lift-off ok, simple hand deployed or winch
- Leverage internal IMS & vendor cross-functional knowledge & tools
- Technology & IMS knowledge transferable to other applications.

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Quantifying RFT Indications/Defects

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RFT in practice

VT, Rower, PAUT, Pit Gauges, replica - all selected as in-house tools for confirmation of RFT indications

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Example 2: Pipe “Screening” - GWT/PAUT

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General Concept of Guided Wave Testing:

- Propagates along component using pipe wall to “guide” ultrasound travel
- Changes in x-section or impedance provides a reflection indication on data
GWT Pipe Screening Cont’d…

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GWT Pipe Screening Cont’d…

PAUT Confirm Depths

Original In-field GWT

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Example 3: PAUT & PAUT Screening

Piping Welds: PAUT Scanners (IQ)

IQ POD Study

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Corrosion PAUT “Wheel-probe” Screening
- Fast PAUT “screening”~4in/sec
- FAC/pitting-sensitive
- Simple water mist for couplant
- Conformable wheel
- Follow-up local areas of interest with existing MIC PAUT Sizing Procedure
Example 4: Reverse Engineering: Defects of Interest

Field Sample

Laser Scan/3D CAD

High Resolution CNC Machining

RFT Inspection Technique

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Conclusions

- Aging plant piping requires more advanced “screening”
- Suite of tools most effective – no “Silver Bullet”
- GWT, RFT and PAUT work effectively to complement each other for speed and focusing effort on most severe defects
- OPG sees an increased need to grow these technologies for its aging plants as well as the new refurbished sites
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QUESTIONS?