



PIPELINES 2025 CONFERENCE

Tampa, Florida | August 9–13



Title: Pro-Active Knowledge-Based PCCP Pipe
Asset Management Program
Presenter: [Scott Popovic](#)





Pro-Active Knowledge-Based PCCP Pipe Asset Management Program

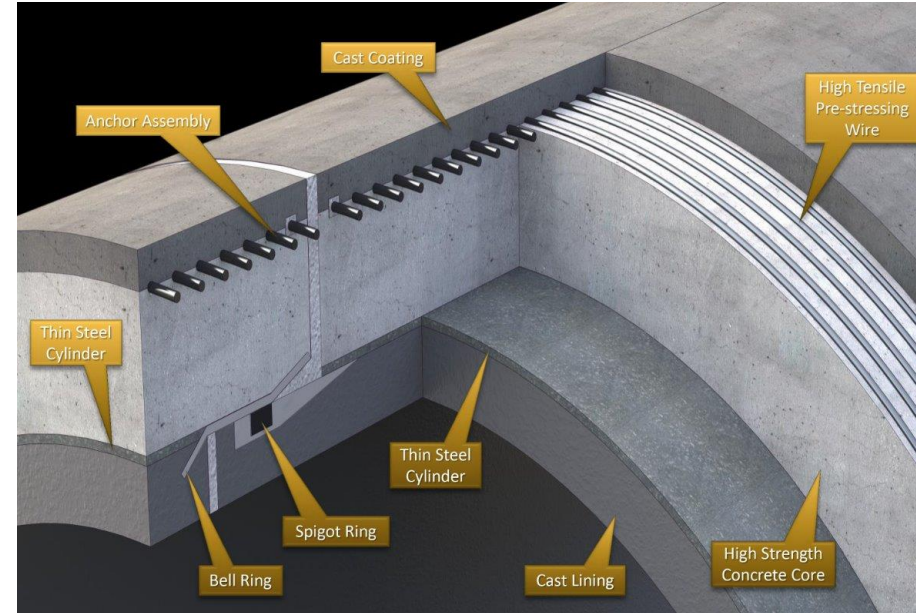
Speaker [Scott Popovic, Solutions Engineer, PICA Corp.](#)



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Pre-Stressed Concrete Cylinder Pipe (PCCP)

- Commonly used for large diameter, potable and raw water transmission mains
- 3 key components:
 - High strength concrete core
 - Thin steel cylinder
 - High tensile pre-stressing wires
 - Found in both lined (LC-PCCP) and embedded (EC-PCCP) formats



PCCP Failures

PCCP failures can be catastrophic and lead to:

- Extended service interruptions
- Sink holes
- Property damage
- Local flooding



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Mechanism of Failure

- Cracks in mortar allow water to corrode the pre-stressing wires
- Corrosion continues beyond the wires to the steel cylinder, allowing more water and oxygen to accelerate the process
- When enough adjacent wires break, the cylinder fails



Hydrogen Embrittlement

- Some pre-stressing wires may experience Hydrogen Embrittlement (HE) and not corrosion
- Hydrogen Embrittled wires:
 - Can occur at any clock position, and on non-adjacent wires
 - May not result in any significant separation of the wires
 - Wires can retain some or all pre-load on the cylinder
 - May not pose imminent integrity threats to the pipe



Wire Breaks – Hydrogen Embrittlement (HE) vs. Corrosion



HE wires show only small separation



Corroded wires lose bond and recoil



Historical PCCP Asset Management

- PCCP assets have typically been inspected using [Near Field Testing \(NFT\) technology](#)
- NFT uses a weak electromagnetic (EM) field to identify broken wires in PCCP
- Replacing all pipe segments with broken wires is not always feasible



PICA & TRWD Pilot Study



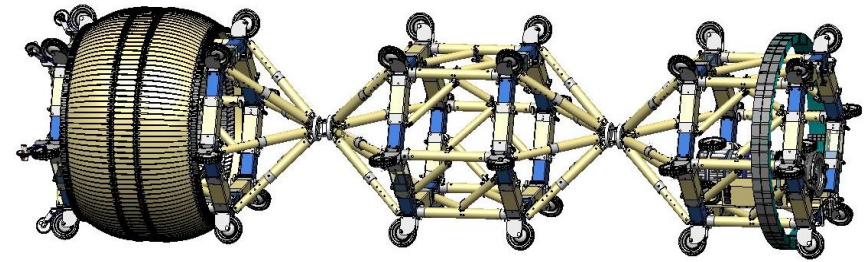
- Tarrant Regional Water District (TRWD) operates over 260 miles of PCCP
- After several catastrophic failures of 1970's vintage pipe, TRWD developed a proactive, knowledge-based asset management program that successfully reduced the number of failures to 0
- TRWD partnered with PICA to conduct a series of trials to enhance the program, with the goal to focus on replacing only segments with the highest risk of failure



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PICA's Advanced NDT Tool

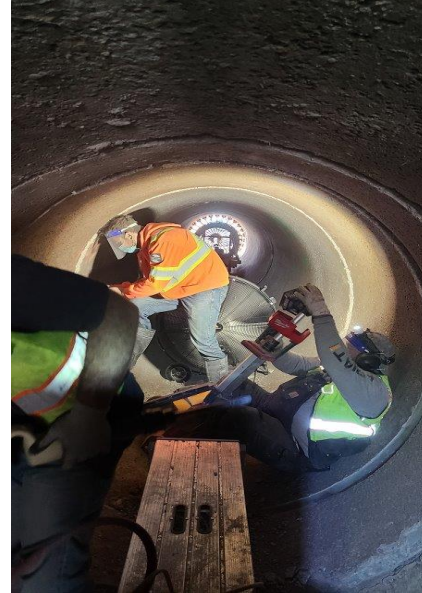
- [PICA's Advanced NDT tool uses Remote Field Testing \(RFT\) technology](#)
- RFT creates a strong electromagnetic (EM) field, with multiple sensors spaced circumferentially around the pipe wall



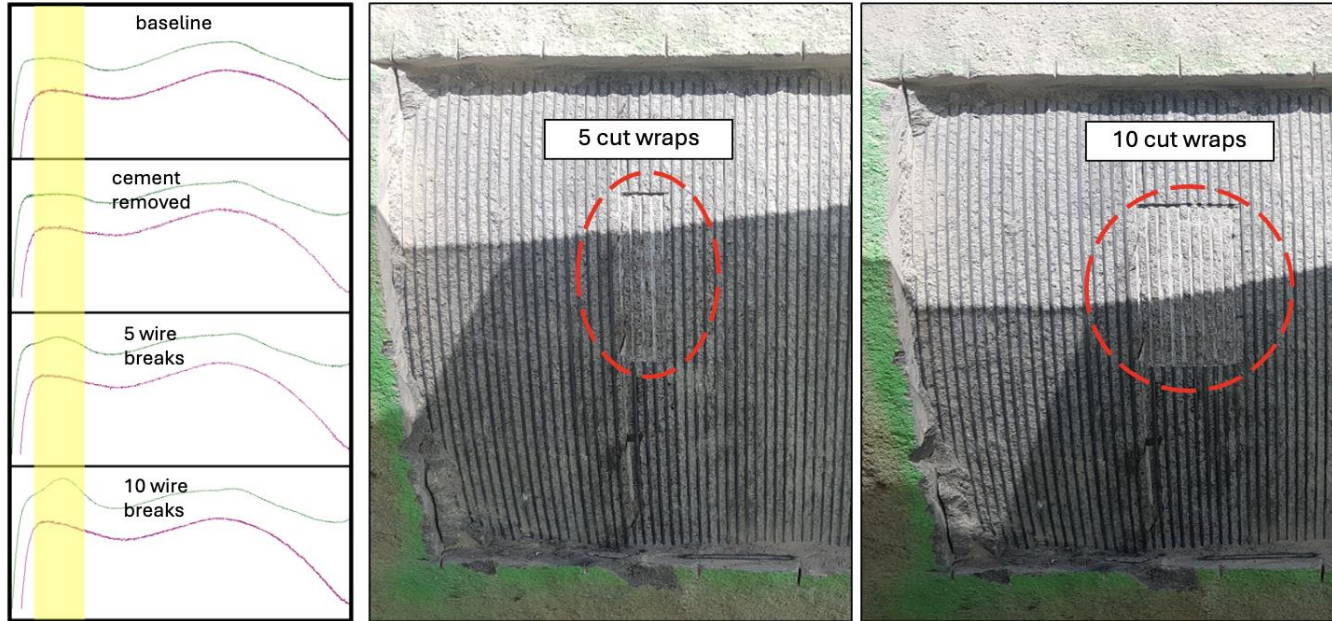
PICA/TRWD Pilot Study Overview

- A series of Advanced NDT scans were completed on excavated segments of PCCP, as well as a 5,000' buried section of pipeline
- Following the completion of baseline testbed scans, [PICA](#) technicians modified the pipe segments by removing mortar, and incrementally altering and cutting pre-stressing wires
- Strain gauges and hydraulically tensioned straps were used to monitor and artificially reintroduce pre-load on the cylinder before and after wires had been cut

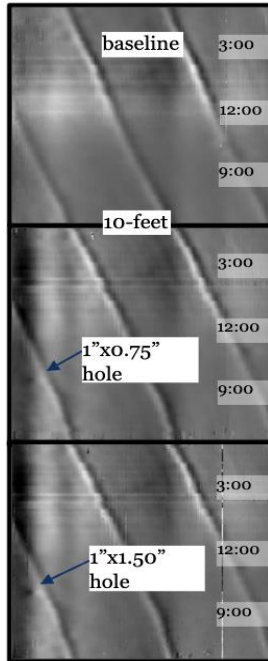
PICA/TRWD Pilot Study Photos



Advanced NDT Results - Cut Wires



Advanced NDT Results – Cylinder Corrosion



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Altering and Monitoring Cylinder Pre-load



Field Testing & Verification



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Results of Destructive Testing



- [Advanced NDT](#) results showed scattered broken wires and no loss of pre-load, suspected to be HE
- Destructive testing indicted a less than 10% loss of new strength, suggesting pipe was at minimal risk of failure while buried

Advanced NDT Conclusions

PICA's Advanced NDT (RFT) tool was found to be capable of measuring three variables in PCCP:

- Conductivity – Almost exclusively coming from pre-stressing wires. Broken pre-stressing wires cause changes in conductivity. Broken wires were identified with a similar sensitivity using both RFT and NFT.
- Relative Magnetic Permeability – A measurement of pre-load or stress on the steel cylinder. Localized changes in magnetic permeability in the RFT data represent a loss of pre-load.
- Steel Wall Thickness – Exclusively coming from the steel cylinder. RFT can directly identify the axial and circumferential location of cylinder corrosion.



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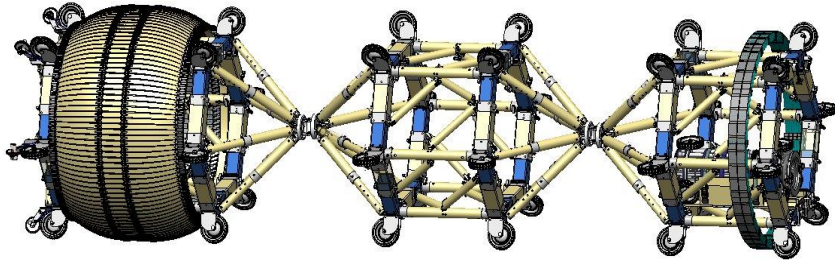
Using Advanced NDT (RFT) to Target Repairs

Three possible combinations of the measured variables exist and can be used to aid decision making following an inspection.

- Change in conductivity **without** a change in permeability – Wires are likely broken due to Hydrogen Embrittlement and there is no loss of pre-load. Pipe should be monitored for worsening condition.
- Change in conductivity **and** a change in permeability – Wires are likely corroded, with enough broken wires to release pre-load on the cylinder. Pipe should be repaired at earliest convenience.
- Change in conductivity, permeability, **and** a reduction in wall thickness – Wires are likely corroded, pre-load is released, and cylinder is corroding. Pipe is a target for emergency repair and is at imminent risk for failure.



Thank you! Questions?



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