Internal Ultrasonic System Shows Promise for Buried Pipe Inspection

A flow-conveyed in-line inspection tool tested on an EPRI mock-up successfully traversed a complex configuration and identified localized pipe thinning.

EPRI is investigating improved inspection technologies as part of a multi-faceted effort to enhance the understanding and management of underground piping and tanks at nuclear power plants. An ultrasonic immersion technique tested on an 8-inch-diameter, 60-foot pipe run containing both horizontal and vertical sections and six elbows successfully navigated all obstructions and detected pipe thinning. Direct examinations with such in-line inspection tools can potentially eliminate excavations, although plants may need to make plant modifications to accommodate launch and retrieval.

Piping mockups containing actual or simulated corrosion are necessary to evaluate the capabilities of buried pipe nondestructive evaluation (NDE) technologies. Because only limited field-removed corroded piping has become available from industry, EPRI has constructed various 4-inch (102-mm), 8-inch (203-mm), 10-inch (254-mm), and 16-inch (406-mm) diameter pipe mockups containing discontinuities of different shapes, depths, and extents. The characteristics of each of these discontinuities are well documented to facilitate NDE technology evaluation.

Ultrasonic immersion tool tested at EPRI for buried pipe inspection. Photo courtesy of Quest Integrity.

The flow-conveyed in-line inspection tool that EPRI evaluated contains an array of transducers distributed around the circumference (see figure). The number of transducers is dependent on the diameter of the tool, but can vary from as few as 48 on a small-diameter tool to 168 or more on a large-diameter tool. The transducers are electronically pulsed at high rates to ensure coverage, and data downloaded via a USB port to a laptop is immediately verified to assure data quality. The tool incorporates centering devices along its length to position and propel the tool along the length of the pipe.

The tool can negotiate multiple short-radius and 180-degree bends while traveling at speeds up to 24 inches per second. In the EPRI assessment, the tool navigated a mockup with six elbows, one of which was a one-diameter bend elbow to confirm that the tool could negotiate such a bend. This is important because many in-line inspection tools are only able to negotiate a 1.5-diameter bend. The ultrasonic immersion tool flowed through the entire 60-ft mockup in less than 1 minute, acquiring data throughout. The tool was flowed back and forth through the mock-up for a total of three trips without incident.

Results collected with the ultrasonic immersion tool were analyzed with data analysis software to identify and characterize wall thinning. The software, which can display both two-dimensional and three-dimensional images, successfully identified multiple locations of simulated thinning on the pipe mockup, including one section of localized thinning at a depth of 0.10 inches. Such tools also can be used to detect dents in the pipe.

Additional assessments of other technologies are being planned for 2012. Candidate technologies include a remote field testing technique and a robotic ultrasonic inspection tool.

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