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Army's "Fury" Tank Inspection System Ensures Accurate, Cost-Effective Assessment

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With several thousand underground storage tanks (USTs) in operation throughout the nation, the U.S. Army has a significant stake in developing and using reliable, cost-effective methods to ensure the tanks' preservation and reliability. Without proper inspection and protection, steel USTs are highly susceptible to corrosion damage, causing loss of product, environmental contamination, and noncompliance with U.S. Code of Federal Regulations 40 CFR 280-281.

The regulation, enforced by the U.S. Environmental Protection Agency since December 1998, requires that all existing USTs be brought into compliance by upgrading with cathodic protection (CP), internal lining, total replacement, or closure depending on the tank's condition. The integrity of USTs that are 10 or more years old must be ensured prior to upgrade.

In the mid-1990s, the Army determined that a cost-effective and reliable compliance option was a condition assessment followed by upgrading with a CP system. To ensure an accurate condition assessment without digging, physical inspection, tank damage, and other time-consuming and potentially dangerous site disruptions, the Army's Construction Engineering Research Laboratory (CERL) designed a remote, robotic UST condition inspection/assessment system named "Fury." Developed in conjunction with RedZone Robotics of Pittsburgh, Pennsylvania, with funding from a Small Business Innovative Research (SBIR) Phase II contract, Fury can typically inspect a 30,000- to 50,000-gallon UST in less than a day, compared to two to five days for conventional, invasive, and more costly methods.

Fury is a robotic crawler that moves inside a UST by means of magnetic wheels. Controlled by a tether and weighing about 25 pounds, Fury can fit through an existing small-diameter pipe (minimum four inches), enter the tank, and conduct a thorough, nondestructive evaluation of tank wall thickness. It has 90-degree transition arms for positioning on tank end-caps and a central pivot to allow for full motion of the steering head. It uses ultrasonic transducers on a sensor sled to obtain approximately 90,000 wall-thickness measurements per hour at more than 95% of the cylinder wall and end-cap locations.

Fury also is being used to assess the condition of sheet pile. In a project conducted in 1999, it successfully determined the condition of underwater steel sheet pile bulkheads in the Cuyahoga and Old Rivers in Cleveland, Ohio, and was used to project the lifetime of the structures.

"Numerous validation efforts have conclusively proven Fury's effectiveness at assessing the condition of USTs and submerged steel piling," said CERL researcher Charles P. March. "In 1998 we were awarded an Army Research and Development Achievement Award for this work, and two patent applications have been filed." He noted that innovations in materials in recent years have led to improved tank construction and design compared to the mid-1990s when Fury was



Fury remote-monitoring system for tank inspection.

developed. "Although the domestic industry has recently gotten away from steel USTs in favor of various nonmetallic designs, there is still strong interest in our inspection technology in the U.S. and internationally," he said.

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