**Hanford Double-Shell Primary Tank Bottom Inspection Technology Development**

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ABSTRACT

he 27 in-service double-shell tank (DST) systems at Hanford provide storage for millions of gallons of radiological and chemical legacy waste. The safe and reliable storage of the waste is critical to the Site’s extended cleanup mission. While in service, the leak integrity of the DSTs must be demonstrated to satisfy regulatory requirements, inform decisions on tank management, and gauge fitness for continued service beyond their original design lives. The primary tank sidewalls and lower knuckles are routinely examined by nondestructive testing using ultrasonic inspection technology to determine the extent of corrosion occurring that could compromise tank leak integrity. However, due to limited physical access, the bottoms of these primary tanks have only been visually inspected since the DSTs were constructed between the years of 1968 and 1986.

Inspection technology is part of a multifaceted approach to the Tank Integrity & Refurbishment Technology Development Program (TI&R). The purpose of this program is to identify, develop, and enable successful deployment of the new or enhanced technologies applicable to several categories of DST integrity. These categories include inspection, integrity monitoring support, and refurbishment. Tank inspection is divided into an additional two types of non-destructive examination (NDE): (1) surface and (2) volumetric. Volumetric NDE is the primary focus herein.

During the down selection process in fiscal year (FY) 2017 Washington River Protection Solutions (WRPS) in conjunction with Guidedwave, Eddyfi, Pacific Northwest National Labs (PNNL), and Southwest Research Institute (SwRI) began developing NDE technologies to improve inspection technology capabilities within the current portfolio available to WRPS inspection groups. Two distinct technologies are being developed to inspect the tank bottoms; one has a higher resolution than the other, therefore they will be used together in a program plan to gather enough data to inform decisions on tank management.

The higher resolution technology: Robotic Air-slot Volumetric Inspection System (RAVIS) uses of a long-range guided wave phased array sensor for defect identification. The RAVIS sensor and associated robotic system is being developed to physically access the under-tank environment through existing air-slot channels within the refractory pad, located between the primary tank bottom and the secondary liner bottom. The newly developed sensor for the RAVIS system is a first-generation sensor which is being qualified to new standards that have not been set by any other sensor in this class, in doing so, newly established requirements and testing methodologies have originated from this developing sensor technology.

The lower resolution system: Remote Robotic Electro Magnetic Acoustic Transducer (EMAT) Volumetric Inspection System (RREVIS), is also in development and has been designed to inspect the tank bottom while precluding the need to physically access the under-tank environment, significantly reducing the complexity and risk of deployment. Although this technology can identify flaws in the tank bottom, the resolution of this technology does not show sufficient information to quantify the flaw at a high fidelity. To provide additional and higher fidelity of data, the RAVIS will be deployed to any problem areas identified by the RREVIS. Using both technologies will give a higher confidence of data collected.

The RAVIS has completed the last phase of qualification testing and the final sensor data analysis has begun. Qualification testing was performed on a small portion of a full-scale tank bottom mock-up that was developed to meet the testing requirements with both blind and known flaws. In parallel with robotic and sensor performance evaluation and improvement, data acquisition and analysis software has been developed and is in development for ease of use and to provide consistent and reliable interpretation of the data.

At the conclusion of all qualification activities, the RAVIS and RREVIS will move to the next phase of the program: field deployment. The Tank and Pipeline Integrity (TAPI) group will begin the process of developing a new inspection program plan based on results of simulated or actual field deployment testing.

**Keywords:** Double-Shell Tanks, Waste, Ultrasonic testing, guided wave, Electro Magnetic Acoustic Transducer