Site Need Statement

General Reference Information	
1 *	***Need Title:*** Adapting Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the Double-Shell Tanks (DSTs)
2 *	***Need Code:*** RL-WT022
3 *	***Need Summary:*** Compliance to Washington Administrative Code (WAC) 173-303-640 requires life cycle integrity assessments, including non-destructive evaluation (NDE) of 6 DSTs on a portion of the tank wall, bottom knuckle, and bottom. Washington Administrative Order 00NWPKW-1250/1251 provides additional examination requirements for knuckle examinations. Additional DSTs will be selected for NDE based upon examination results. NDE equipment must be deployed to fulfill this requirement. Fracture mechanics analysis indicates that the knuckle region of the DST that rests on the concrete foundation is the highest-stressed region of the tanks. This high-stressed region is not accessible using current ultrasonic technology. A promising alternative for accessing this region is by propagating ultrasonic energy around a plate with a one-foot radius bend. Current inspection studies demonstrate that defects in this region can be detected. However, characterizing length and through-wall extent of defects is not possible using current technology.
4 *	***Origination Date:*** FY 2000 (3/24/99)
5 *	***Need Type:*** Technology Need
6	***Operation Office:*** Office of River Protection (ORP)
7	***Geographic Site Name:*** Hanford Site
8 *	***Project:*** Safe Storage/Tank Farm Operations **PBS No.:** RL-TW03
9 *	***National Priority:*** X 1. High - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. ____ 2. Medium - Provides substantial benefit to EM program projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). ____ 3. Low - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	***Operations Office Priority:*** High
Problem Description Information	
11	***Operations Office Program Description:*** The overall purpose of the safe-storage function is to operate and maintain the double shell tank (DST) and single shell tank (SST) farms in a safe and compliant manner until the contained wastes are retrieved and the tank farms are ready for closure. This includes performing day-to-day operations, maintaining and upgrading infrastructure, resolving safety issues, assessing tank integrity, characterizing the waste, and managing the DST waste inventory. This function also includes interim stabilization of selected SSTs. The end state of safe storage is containment of DST and SST tank wastes in a manner that supports safe waste retrieval for final waste disposal; tank-farm structures, including DSTs and SSTs, ready for final disposal and closure; and tank farms amenable and ready for the mitigation of any environmental releases that occurred during storage and retrieval of tank waste.
12	***Need/Problem Description:*** Comprehensive NDE of DST primary and secondary tank walls is required by W commitment and for evaluations of remaining useful DST life. Ensuring the structural integrity of the current tanks while developing innovative solutions to waste management and consolidation is the main mission of contractors at the Hanford reservation. The next challenge in ensuring the integrity of the double shell tanks requires the examination of the knuckle of the tank. This examination poses a significant technical challenge because a portion of the area that requir examination is not easily accessible. Initial studies conclude that detection of defects in the knuckle region is problem. However, characterizing the defect length and through wall extent presents a very difficult problem

	TSAFT imaging technology is a promising technology that provides a potential solution for characterizing de the knuckle region of the waste tanks. The technology needs to be adapted to the geometry of the knuckle reg and sound propagation distances of up to four feet. **Consequences of Not Filling Need:** Regulatory Impacts: The U. S. DOE has previously entered into negotiations with the Washington State Department of Ecology (WDOE) and the U. S. Environmental Protection Agency for determination of acceptable compliance with W 173-303-640. Completion of DST NDE was a part of these negotiations. Failure to complete this activity mi construed by WDOE as failure to comply with WAC commitments and WAC legal requirements. Washingto Administrative Order 00NWPKW-1250/1251 requires examination of knuckle areas by FY2005. Programmatic Impacts: If TSAFT technology is not developed, a majority of the high-stress region of the kn that rests on the concrete foundation may not be able to be examined. The inability to examine critical sectio the tank creates a major knowledge gap when attempting to assess the near-and long-term integrity of the tan ** **Program Baseline Summary (PBS) No**.: RL-TW03 ** **Work Breakdown Structure (WBS) No.:** 5.02.02.01.01.23, 5.01.03.05 ** **TIP No.:** T03-05-300, "Assess Need for DST Replacement," April 2005
13	Functional Performance Requirements: Functional requirements for ultrasonic inspection capable of characterizing defects in the knuckle region include: • Propagating ultrasound a distance of four feet around a plate with a one-foot radius. • Detect cracts that exceed 0.18 inches and determine the through wall extent to an accuracy of ±0.1 inches. • Detect corrosion pitting that exceeds 25% wall thickness and determine the through wall extent to an accuracy of ±0.05 inches.
**	**Schedule Requirements:** The system can be deployed in fiscal years 2002 and 2003 to meet life cycle assessment commitments. The project for adapting the ultrasonic tandem synthetic focusing technique (TSAFT) technology for characterization of flaws in the high-stressed knuckle region of the double-shell tanks requires approximately six calendar months. The project started in fiscal year 2001 to ensure that this technology for evaluation of tank integrity is available to inspection service companies in fiscal year 2003.
14	***Definition of Solution:*** Develop tools to examine currently inaccessible regions of the DST knuckles and bottom
15 *	***Targeted Focus Area***: Tanks Focus Area (TFA)
16	***Potential Benefits:*** Provide assurance to WDOE that the DSTs are fit-for-service until mission completion
17 *	***Potential Cost Savings:*** n/a
18 *	***Potential Cost Savings Narrative:*** TSAFT will allow examination of an area of the DST not accessible to existing NDE techniques. As such, there is no cost savings in the conduct of NDE activities. There may instead by an increased cost associated with NDE. However, cost savings could result if data from TSAFT allows early response to identification of cracking or other flaws in the currently inaccessible region of the tank lower knuckle and bottom, that would otherwise remain hidden until tank failure. Avoiding the need to respond under conditions of tank failure would have a significant cost benefit. Quantifying such cost benefit would be highly speculative.
**	***Technical Basis:*** Present Nondestructive Evaluation (NDE) techniques can only detect and characterize Stress Corrosion Cracks (SCC), corrosion or other anomalies in the narrow slot regions at the bottom of the double-shell tanks. These slot areas only provide access to 1-2% of the high-stress region of the tanks, which is not adequate for integrity assessment. TSAFT technology, developed at PNNL for inspecting components and piping in nuclear reactor systems, has the potential for providing detailed characterization of cracking or corrosion in the entire knuckle region of the tanks.
19	***Cultural/Stakeholder Basis:*** The oversight committee on tank integrity has identified inspection of the knuckle region of double shell tanks as critical. Adapting TSAFT technology that can successfully complete

	a performance demonstration will resolve the issue of inspection of the double shell tanks.
20	***Environment, Safety, and Health Basis:*** Assessing the integrity of the DSTs reduces the risk of catastrophic leaks. Early detection of any degradation of DSTs provides an opportunity to plan and develop corrective actions in the event of potential failure.
21	***Regulatory Drivers:*** Completion of the physical examinations of the DSTs is required by WAC commitment a prerequisite for obtaining Resource Conservation and Recovery Act (RCRA) Part B permit status for contin operation of the DST system. Washington Administrative Code 173-303-640(2)(c)(v) requires a physical examination or leak test as a part of an integrity assessment program. Washington Administrative Order 00NWPKW-1250/1251 requires examination of knuckle areas by FY 2005.
22 *	***Milestones:*** TPA and WAC for FY2005
23 *	***Material Streams:*** ID-2113 Sludge, Salt, Liquid Risk Score: 3 RL-HLW-20
24	***TSD System:*** Double-Shell Tank System
25	***Major Contaminants:*** Pu-238, 239, 240, 241; AM-241; U-238; C-14; Ni-59/63; Nb-94; Tc-99; I-129;Cm-242; Sr-90; Cs-137; Sn-126; Se-79; chromium; nitrate; nitrite; complexants (EDTA/HEDTA)
26	***Contaminated Media:*** Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	***Volume/Size of Contaminated Media:*** All double shell tanks are 75 feet in diameter, and about 40 feet deep, with their tops buried about 10 feet below the ground surface.
28 *	***Earliest Date Required:*** FY 2002
29 *	***Latest Date Required:*** FY 2003
Baseline Technology Information	
30	***Baseline Technology/Process:*** Baseline NDE technology is capable of detecting and characterizing stress corrosion cracks (SCC), corrosion or other anomalies in the narrow slot regions at the bottom of the double-shell tanks. These slot areas only provide access to 1-2% of the high-stress region of the tanks, which is not adequate for integrity assessment. The narrow slot limits the length measurement of defects. Moreover, the ability to identify pitting and cracking is limited. **Technology Insertion Point***:* T03-05-300, "Assess Need for DST Replacement," April 2005
31	***Life-Cycle Cost Using Baseline:*** TBD
32	***Uncertainty on Baseline Life-Cycle Cost:*** TBD
33	***Completion Date Using Baseline:*** *FY2005*
Points of Contact (POC)	
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*Element of a Site Need Statement appearing in IPABS-IS
** Element of a Site Need Statement required by CHG