Site Need Statement

General Reference Information	
1 *	***Need Title:*** Contaminant Mobility Beneath Tank Farms
2 *	***Need Code:*** RL-WT053-S
3 *	***Need Summary:*** Quantify and understand the evolution of the present distribution of contaminants, both radioactive and nonradioactive (particularly cesium-137, but also Pu, Tc-99, Sr-90, Cr, and nitrate), beneath the tank farms and to evaluate their potential mobility under all "leave or retrieve" options. The current understanding of the mobility of contaminants from single-shell tank leaks and major soil column transuranic disposal sites is inadequate to fully support cleanup, closure, or performance assessment-related decisions. Notably, borehole logging in SX Tank Farm revealed cesium-137 at depths of 130 ft, significantly deeper than predicted by current models. Further investigations, including the drilling of two additional wells, confirmed the presence of migrated cesium in the formation. The report issued by the River Protection Project Vadose Zone Expert Panel concluded that cesium migration was poorly understood and that insufficient data were available to validate migration models. Without knowledge about the distribution of contaminants beneath the tank farms, and without the ability in hand to predict contaminant movement, it will be impossible to assure the public that the DOE can predict: • the impact of leaks during sluicing of the tanks during cleanup • the impact of leaving the tanks (and their associated subsurface contamination) in place. Furthermore, the vadose zone cleanup schedule for the 200 Areas could be delayed if the mobility status of deeply distributed contaminants is unknown or inadequately characterized well in advance. For example, if it is eventually determined that retrieval of TRU-contaminated soil down to 40 m or more beneath PFP cribs is required, the cleanup schedule could be greatly impacted due to financial requirements for excavation and handling costs that could approach 1 billion dollars or more. Similar excavation requirements for leaking single-shell tanks (SSTs) could drive the costs of cleanup higher by several orders of magnitude. The sooner this issue is resolved, the sooner more accurate technical, financial and schedule forecasts can be made.
4 *	***Origination Date:*** FY 2000
5 *	***Need Type:*** Science Need
6	***Operation Office:*** Office of River Protection (ORP)
7	***Geographic Site Name:*** Hanford Site
8 *	***Project:*** Closure PBS No.: RL-TW11
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:***
Problem Description Information	
11	***Operations Office Program Description:*** The overall purpose of the Closure function is to close SST and DST tank farms and RPP facilities. Closure of tanks and tank farms assumes that waste retrieval will remove sufficient waste from the tanks that the residual wastes following retrieval, the tanks themselves, the tank farm ancillary equipment, and the contaminated soil will be disposed in place in accordance with applicable regulations and agreements. This strategy also assumes that the residual waste and other tank farm source terms will be considered by the U. S. Nuclear Regulatory Commission to be incidental waste, i.e., non-high-level waste. This function has substantial involvement with studies directed at understanding contaminant migration in the vadose zone and groundwater that are part of the Hanford Groundwater/Vadose Zone (GW/VZ) Integration Project.

12	***Need/Problem Description:*** Spectral gamma logging of drywells around underground single-shell tanks (SSTs) has provided valuable data on penetration of gamma-emitting contaminants from tank leaks into the soil beneath tanks. Knowledge of the inventory and distribution of contaminants from past tank leaks, and mechanisms that have controlled their movement, will be important in assessing risk implications from past leaks and potential future leaks during retrieval, and making decisions on whether or what remediation efforts may be needed for closing tank farms, or for taking interim corrective actions prior to tank farm closure. This science need supports the Hanford tanks technology need RL-WT061 Reactive Barriers to Contaminant Migration. This need is described in Section 10.3.8 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0. **Consequences of Not Filling Need:** Cleanup decisions will lack technical defensibility. ** **Program Baseline Summary (PBS) No.:** TW11 ** **Work Breakdown Structure (WBS) No.:** 5.05.01.01 ** **TIP No.:**
13	***Functional Performance Requirements:*** <u>Colloidal transport mechanisms.</u> Studies are needed to evaluate the importance of colloids in enhancing the migration of radionuclides. <u>Soil fixation/binding mechanisms.</u> Current predictive models of contaminant transport beneath single-shell tanks rely on general K_d information derived from laboratory sorption studies in synthetic media. The extreme chemical conditions associated with tank liquor (pH up to 14) and PFP crib discharges (pH to -1), and the associated changes in sorptive properties of the porous media, are difficult if not impossible to simulate. Prior characterization studies (mid 70's) provided valuable information on which to build. However, due to moderately slow changes in subsurface conditions over time (e.g., silicate hydrolysis), the pH and other chemical conditions in the soil column beneath receiving sites may be different today than 20-25 years ago. Thus, contemporary contaminated media is needed to assess the existing field mobility status of major contaminants in the soil column. The sorptive mechanisms need to be assessed to determine how tightly bound Sr-90, Cs-137, Pu, and Am are today. This involves the following: • extraction of pore fluid (free fraction) and the "reverse" of laboratory sorption studies (i.e., leaching or desorption studies) using actual contaminated media • assessment of the role of potential chemical reactions induced by the soil mineral fraction. For example, what is the role of iron (II) rich silicate minerals (pyroxenes) present in Hanford soils on reduction-sorption of transuranics? Acid hydrolysis due to the acidity of the effluent may have enhanced the reducing capability of iron (II) rich minerals and resulted in irreversible sorption of transuranics (Johnson and Hodges, 1997, *Second Symposium on Hydrogeology of Washington*, abstracts). Hot, high-pH media (original tank waste) also modify the soil matrix in unpredictable ways. Silicate minerals dissolve and reprecipitate, colloids may form, etc. Actual modified media is needed to evaluate existing conditions. Additional or supplemental work is needed for a comprehensive assessment of 200 Area soil column disposal and tank farm sites. <u>Development of a modeling tool.</u> A computer code should be developed to model the migration of radionuclides due to tank leakage incorporating the unique considerations described above (e.g., high pH, colloidal transport, moderately unsaturated to saturated conditions, etc.). The model should combine time and spatially-dependent geochemical modeling with transient moisture flow and contaminant transport and allow the determination of modeling and data uncertainties. The simulator must handle geometrically complex objects and a large number of chemical species. The code should be structured to economically address the quantification of sensitivity of responses to uncertain physical and geochemical model parameters. Transport phenomena should include not only transport through homogenous media but also transport through fractured and preferred vertical flow paths (such as clastic dikes). This effort should build on the work that Jacobs Engineering has already done as part of the Hanford Tanks Initiative.
**	**Schedule Requirements:** Over the period FY 1999 through FY 2007 subsurface investigations and laboratory analyses are taking place in the SST waste management areas under RCRA assessment as part of a Phase 1 RFI/CMS

	process addressed in the Tri-Party Agreement. In the first half of FY 2004, an RFI Report is scheduled to be prepared that will summarize results of site-specific investigations, and provide recommendations on additional investigations that may need to be performed to support decisions on controlling existing subsurface contamination, retrieving waste from tanks, and closing tank farms. Improved understanding of transport and fixation/binding mechanisms in this time frame will support recommendations on what additional investigations, if any, may need to be conducted.
14	***Definition of Solution:*** .
15 *	***Targeted Focus Area:*** Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	***Potential Benefits:***
17 *	***Potential Cost Savings:*** $100,000,000
18 *	***Potential Cost Savings Narrative:*** Remediation of contaminated soil, if required as part of interim corrective measures or tank farm closure, could cost in the hundreds of millions of dollars. Improved understanding of transport mechanisms and long-term risk implications will ensure technical defensibility of such decisions
**	***Technical Basis:*** Develop sufficient understanding of factors that control movement of contaminants from tank leaks to develop estimates of inventory and distribution, and to estimate long-term risk consequences. Improved understanding of transport and fixation/binding mechanisms will support cleanup decisions on interim corrective actions, waste retrieval, and tank farm closure.
19	***Cultural/Stakeholder Basis:*** Regulators and stakeholders insist on developing a much better understanding of subsurface conditions and processes than presently exist, prior to making critical decisions on waste retrieval and closure of tank farms.
20	***Environment, Safety, and Health Basis:*** Decisions on interim corrective actions and tank farm closure will address risks to workers and the public from remediation activities. These risks will be evaluated and compared to long-term risks associated with contaminants that remain in the environment from tank leaks. Improved understanding of transport and fixation/binding mechanisms will support estimates of long-term risk, as well as estimates of inventory and distribution of contaminants in the soil that may need to be remediated.
21	***Regulatory Drivers:*** Single-shell tanks are RCRA TSD units, regulated under WAC 173-303. Tri-Party Agreement milestones adopted under Change Control Form M-45-98-03 require investigation of the SST waste management areas under a RFI/CMS process. Additional Tri-Party Agreement milestones under the M-45 series require retrieval of waste and closure of tank farms in a manner that protects public health and the environment. The Record of Decision for the RPP EIS requires a NEPA process for making decisions on tank farm closure, once a sufficient understanding of vadose zone conditions and processes is attained.
22 *	***Milestones:*** Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
23 *	***Material Streams:*** Soil (Disposition Map Designations: ER-04: LLW Soils 100/300 Area, ER-14: LLW Soils 200 Area, ER-03: MLLW Soils); Sludge, Salt, Liquid (RL-HLW-20); Soil (Disposition Map Designations: ER-14: LLW Soils 200 Area)
24	***TSD System:*** 200 Area liquid discharge sites; ILAW disposal facility; SST farms; DST farms
25	***Major Contaminants:*** Not applicable
26	***Contaminated Media:*** Hanford vadose zone. Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	***Volume/Size of Contaminated Media:*** The single shell tanks are generally 75 ft. in diameter, and up to 40 feet deep with their tops buried about 10 feet below the ground surface.
28 *	***Earliest Date Required:*** FY 2001
29 *	***Latest Date Required:*** September 2008
Baseline Technology Information	
30	***Baseline Technology/Process:*** **Technology Insertion Point(s):**

31	***Life-Cycle Cost Using Baseline:***
32	***Uncertainty on Baseline Life-Cycle Cost:***
33	***Completion Date Using Baseline:***
Points of Contact (POC)	
34	***Contractor End User POCs:*** F.M. (Fred) Mann, CHG., 509-372-9204, F/509-372-9447, Frederick_m_mann@rl.gov
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36 **	***Other Contacts:*** K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov A.F. (Anne-Marie) Choho, NHC, 509-509-372-8280, F/509-373-6382, Anne-Marie_F_Choho@rl.gov

*Element of a Site Need Statement appearing in IPABS-IS
**Element of a Site Need Statement required by CHG