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E. Required Information 1. Is document potentially Classified? ☒ No ☐ Yes (MANDATORY) <i>See below for signature</i> Manager's Signature Required If Yes _____ ☒ No ☐ Yes Classified ADC Signature Required 2. References in the Information are Applied Technology ☒ No ☐ Yes Export Controlled Information ☒ No ☐ Yes		3. Does Information Contain the Following: (MANDATORY) a. New or Novel (Patentable) Subject Matter? ☒ No ☐ Yes If "Yes", Disclosure No.: _____ b. Information Received in Confidence, Such as Proprietary and/or Inventions? ☒ No ☐ Yes If "Yes", Affix Appropriate Legends/Notices. c. Copyrights? ☒ No ☐ Yes If "Yes", Attach Permission. d. Trademarks? ☒ No ☐ Yes If "Yes", Identify in Document. 4. Is Information requiring submission to OSTI? ☐ No ☒ Yes 5. Release Level? ☒ Public ☐ Limited HPB30121																															
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Hanford Science and Technology Needs Statements, 2002

**Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management**

**Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200**

**United States
Department of Energy**
P.O. Box 550
Richland, Washington 99352

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**United States
Department of Energy**
P.O. Box 550
Richland, Washington 99352

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INTRODUCTION

In the aftermath of the Cold War, the United States has begun addressing the environmental consequences of five decades of nuclear weapons production. In November 1989, DOE established the Office of Environmental Restoration and Waste Management (EM) as the central authority for cleaning up the DOE weapons complex legacy of pollution, for preventing further environmental contamination, and for instituting responsible environmental management. While performing its tasks, EM found that many aspects of its large and complex mission could not be achieved using existing science and technology or without incurring unreasonable costs, risks, or schedule impacts. Consequently, a process was developed to solicit needs from around the DOE complex and focus the science and technology resources of EM-50, the National Laboratories, private industry, and colleges and universities on those needs. This document describes those needs that the Hanford Site has identified as requiring additional science or technology to complete.

PURPOSE

This document: (a) provides a comprehensive listing of the Hanford sites science and technology needs for fiscal year (FY) 2002; and (b) identifies partnering and commercialization opportunities within industry, other federal and state agencies, and the academic community. These needs were prepared by the Hanford projects (within the Project Hanford Management Contract, the Environmental Restoration Contract and the River Protection Project) and subsequently reviewed and endorsed by the Hanford Site Technology Coordination Group (STCG). The STCG reviews included participation of DOE-RL and DOE-ORP Management, site stakeholders, state and federal regulators, and Tribal Nations. These needs are reviewed and updated on an annual basis and given a broad distribution.

Copies of the document are available to the public and may be accessed via the Internet on:

- * The STCG web site at <http://www.hanford.gov/boards/stcg/>

Information on Hanford may be accessed via the Internet on:

- * The Hanford Homepage at <http://www.hanford.gov>

Private industry, federal agencies, and colleges and universities are encouraged to review the need statements and contact the Hanford site if they can provide science and technology solutions that meet these needs. On-site points of contact are included at the end of each need statement.

DOCUMENT ORGANIZATION

The Science and Technology Needs Document is organized by major problem areas as follows: Deactivation and Decommissioning, Nuclear Materials Stabilization, Subsurface Contaminants, Waste Management (TRU and Mixed Waste), and Tanks. Each problem area begins with a technology needs index table. This table is followed by detailed descriptions of each technology need, including a problem statement and current baseline information associated with that need. Following the technology need description in each problem area is a table listing the science needs, followed by detailed descriptions of the functional need and the problem to be solved as currently understood. Finally, a crosswalk table is provided at the end of each problem area that ties together last year's needs and this year's needs, identifying updated, new and deleted needs.

DEACTIVATION AND DECOMMISSIONING PROGRAMS

FY 2002 SCIENCE AND TECHNOLOGY NEEDS STATEMENTS

FY 2002 DEACTIVATION AND DECOMMISSIONING TECHNOLOGY NEEDS INDEX

ID #	NEED TITLE	PBS #
DEACTIVATION		
PLUTONIUM FINISHING PLANT (PFP)		
RL-DD02	Glove Box Size Reduction System at PFP	RL-CP03
RL-DD03	Terminal Clean-Out and TRU Waste Decontamination of PFP	RL-CP03
RL-DD04	TRU Waste Fixatives for PFP	RL-CP03
BUILDINGS 324 AND 327		
RL-DD05	Characterization of Buildings 324 and 327	RL-RC06
RL-DD06	Decontamination of Buildings 324 and 327	RL-RC06
RL-DD07	Fixatives for Buildings 324 and 327	RL-RC06
RL-DD08	Remote Cutting Technologies for Buildings 324 and 327	RL-RC06
RL-DD09	Tank Remediation for Building 324	RL-RC06
RL-DD010	Radiation Hardened Robotics for Building 324	RL-RC06
RL-DD011	Structural Integrity Inspection -- 324/327 Buildings Hot Cell Liners	RL-RC06
RL-DD046	Clean-Out of Isolated Piping Systems in Building 324	RL-RC06
RL-DD047	Remote Viewing for Hot Cells in Buildings 324 and 327	RL-RC06
RL-DD077	Duct Cleaning for Buildings 324 and 327	RL-RC06
RL-DD078	Improved Vacuum Recovery Systems for Buildings 324 and 327	RL-RC06
RL-DD079	Improved Crane Technology for Building 324	RL-RC06
RL-DD080	Improved Solid Waste Packaging for Building 324	RL-RC06
RL-DD081	Decontamination of Wet Storage Basin in Building 327	RL-RC06
RL-DD087	High Activity HEPA Filter Changeout at 324 Building	RL-RC06
RD-DD088	Remote Access Technologies for Waste Retrieval in Buildings 324 and 327	RL-RC06
BUILDINGS 310/TEDEF AND 340 VAULT		
RL-DD082	Retrieval of Waste Heel from Vault Tanks at 340 Facility	RL-RC05
RL-DD083	In-Line Radiation Detection at Very Low Levels in Wastewater	RL-RC05
SPENT NUCLEAR FUEL PROJECT		
RL-SNF01	Contaminant Mapping of K Basins	RL-RS03
RL-SNF02	Decontamination of K Basin Pool	RL-RS03
RL-SNF03	Fixatives for K Basin	RL-RS03
DECOMMISSIONING (Environmental Restoration Project)		
SURVEILLANCE/MAINTENANCE AND TRANSITION PROJECT		
Canyon Disposition Initiative (CDI)		
RL-DD034	Remote/Robotic Technologies for CDI	RL-CP01
RL-DD048	Volume Reduction of Equipment for CDI	RL-CP01
RL-DD049	Waste Encapsulation and Stabilization for CDI	RL-CP01
RL-DD051	High Profile Surface Barrier for CDI	RL-CP01
RL-DD052	Long-Term Monitoring for CDI	RL-CP01
RL-DD053	Operational Modeling for CDI	RL-CP01
ADDITIONAL SURVEILLANCE AND MAINTENANCE		
RL-DD055	Remote Monitoring System Upgrades for the S&M Program	RL-CP01
RL-DD057	Long-Lived Roof Replacement for the S&M Program	RL-CP01

ID #	NEED TITLE	PBS #
RL-DD058	Method to Control Deep Rooted Plants for the S&M Program	RL-CP01
RL-DD059	Lead Decontamination for the S&M Program	RL-CP01
RL-DD067	Method for Performing Roof Inspections for the S&M Program	RL-CP01
RL-DD068	New Lubricants for the S&M Program	RL-CP01
RL-DD070	Caisson Sealing Method for the S&M Program	RL-CP01
RL-DD071	Method to Preserve B Reactor Exterior Ductwork for the S&M Program	RL-RC01
RL-DD084	Sealant for Valves Containing Nitric Acid for the S&M Program	RL-CP01
RL-DD085	Non-Destructive Examination and Assaying Techniques for Legacy Waste Box Characterization for the S&M Program	RL-CP01
RL-DD086	Remediation of Hexone Tanks for the S&M Program	RL-CP01
233-S PLUTONIUM CONCENTRATION FACILITY DECOMMISSIONING PROJECT		
RL-DD030	Cutting Plutonium Contaminated Pipe for 233-S	RL-CP01
RL-DD031	Non-Intrusive Detection of Pipe Contents for 233-S	RL-CP01
RL-DD032	Contamination Fixative for 233-S	RL-CP01
RL-DD060	Characterization for Waste Handling, Packaging and Processing for 233-S	RL-CP01
RL-DD062	Method to Capture Airborne Alpha Contamination for 233-S	RL-CP01
RL-DD063	Decontamination of Transuranic Debris for 233-S	RL-CP01
DECOMMISSIONING PROJECTS		
REACTORS INTERIM SAFE STORAGE		
RL-DD033	Field Screening for Hazardous Materials for 105-F and 105-DR Reactors	RL-RC01
RL-DD072	Characterization of the 105-H Spent Fuel Basin	RL-RC01
RL-DD074	Asbestos Abatement for the KE-, KW, And N-Reactor Areas	RL-RC01
RL-DD076	Dense Concrete Demolition for the Interim Safe Storage Project	RL-RC01
ADDITIONAL DECOMMISSIONING		
RL-DD021	Metal Decontamination and Recycling for the D&D Program	RL-RC01
RL-DD073	Mobile Temporary Ventilation System for the Environmental Restoration Project	RL-RC01
DEACTIVATION SCIENCE NEEDS		
RL-DD022-S	Photon-Assisted Decontamination Chemistry	RL-RC06, RL-CP01
RL-DD025-S	Effluent Capture	RL-RC06, RL-CP01
RL-DD026-S	Contaminant Binding Science Need	RL-RC06, RL-CP01
RL-DD035-S	Neutron Detection for Sorting Remote-Handled Radioactive Waste into TRU vs Non-TRU	RL-RC06
DECOMMISSIONING SCIENCE NEEDS		
RL-DD022-S	Photon-Assisted Decontamination Chemistry	RL-RC06, RL-CP01
RL-DD025-S	Effluent Capture	RL-RC06, RL-CP01
RL-DD026-S	Contaminant Binding Science Need	RL-RC06, RL-CP01
RL-DD037-S	Long Term Monitoring Sensors Need	RL-CP01
RL-DD038-S	Remote Monitoring or Structural Integrity Need	RL-CP01

DEACTIVATION

PLUTONIUM FINISHING PLANT (PFP)

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

GLOVE BOX SIZE REDUCTION SYSTEM FOR PFP

Identification No.: RL-DD02

Date: October 2000

Program: Nuclear Material Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: TBD

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant (PFP)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Glove Box Size Reduction System for PFP.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: An ex-situ glove box size reduction system, possibly housed in a skid-mounted, modular containment structure is needed for PFP. The system would provide for size reduction, final decontamination, NDA, and packaging. The system should easily couple to a facility's support services, such as steam, water, air, and electricity. The system could potentially employ technology as identified in Need Statements RL-DD03 and RL-DD04. The system should not be limited to handling glove boxes but should also be applicable to other large items such as piping, ducting, and other metal objects.

Schedule Requirements:

Earliest Date Required: 09/2004

Latest Date Required: 09/2006

Although schedules for selection and installation are not firm, initial selection of the technology should occur in early 2002. The size reduction system will be used in a variety of roles during terminal cleanup and decontamination and decommissioning phases scheduled for FY 2005 through FY 2014. Deployment should occur as early as possible to maximize the benefits from the technology.

Problem Description: Contamination represents an immediate worker exposure and risk concern as well as a long-term environmental concern. Many surface decontamination technologies generate secondary waste streams and are labor intensive and costly.

- a) **Glove Boxes** - Glove boxes have been used to handle radioactive materials for numerous activities. Present decontamination methods rely on personnel physically wiping surfaces. Worker fatigue, exposure, and risk are inherent in these methods. Complete decontamination of glove boxes using these methods is difficult because many surfaces are inaccessible using manual decontamination techniques.
- b) **Piping and Ducting** - Plutonium exists in piping and ductwork in materials processing facilities. The current practice for removing and stabilizing plutonium in pipes and ductwork involves personnel physically cutting the materials, bagging them, and transferring them to glove boxes for decontamination and size reduction. The process is time consuming, costly, and poses a risk of personnel exposure. The waste must be managed as a TRU waste, high-level waste, and/or low-level waste.
- c) **Other Metal Objects** - There are many metal objects that require decontamination. These include glove box equipment such as pipes, tanks, valves, motors, and flanges. Contaminants include plutonium oxide, other transuranics, and variety of tri-butyl phosphate-based organic compounds and degradation products.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The potential life cycle cost savings of an automated, remote handling and size reduction system over manual techniques, requiring hands on operations are on a order of magnitude basis in the tens of millions of dollars. There are hundreds of gloveboxes on the Hanford site to be dealt with, and large numbers of other oversize equipment, as well as many thousands of feet of HVAC ducting and piping systems.

Benefit to the Project Baseline of Filling Need: There is a significant potential to accelerate or provide better potentials to meet schedules for deactivation of facilities at the site.

Relevant PBS Milestone: TRP-14-401, Complete PFP Deactivation, 9/30/16

Functional Performance Requirements: Lessons-learned from previous plutonium (Pu) glovebox Deactivation/Decommissioning Projects indicate a preference to performing an initial gross decontamination in situ to remove the majority of plutonium, focusing on ease of decontamination and high Pu holdup equipment. The glove box would then be packaged, disconnected from facility services, and transported to the ex situ system where final size reduction, decontamination, nondestructive analysis (NDA), and packaging activities would take place. Readily deployable robotics may also be appropriate to minimize worker exposure and risk. Methods that clean to non-transuranic (non-TRU) levels are preferable. Specific applications include the following:

- a) **Glove Boxes** - The primary contaminant is plutonium oxide. Glove boxes contain multiple materials requiring decontamination such as metals in a variety of shapes and sizes. Many of the surfaces are inaccessible using manual decontamination techniques.
- b) **Piping and Ducting** - The primary contaminant is plutonium oxide. The present method is to contain the piping/ducting and remove it for disposal (usually TRU). The "Decon/Size Reduction System" could serve as a receiver of this type of material as well.
- c) **Other Metal Objects** - The primary contaminant is plutonium oxide. Objects requiring decontamination include stainless-steel equipment of varying size but small enough to fit in a nominally-sized glove box. Again, many of the surfaces are inaccessible using manual decontamination techniques.

Work Breakdown Structure (WBS) No.: 1.4.5 – PFP

TIP No.: TRP-02-499

Justification For Need:

Technical: There are several hundred glove boxes at PFP that are potential candidates for disposal at WIPP. Current decontamination methods as applied to whole glove boxes would not be effective in reducing the volume of TRU waste for ultimate disposal as this level of cleaning increases worker exposure and risk, is slow and costly, and produces secondary waste. Size reduction would permit the separation of TRU from non-TRU waste and would provide smaller and more uniform objects for a more production-oriented final cleaning process.

Regulatory: Completion of PFP terminal clean-out to remove all waste materials to a disposition path.

Environmental Safety & Health: Radioactive contamination presents worker safety/exposure concerns.

Cultural/Stakeholder Concerns: A system for size reduction and decontamination will expedite the removal of TRU waste and also minimize the volume of non-TRU waste material destined for onsite burial. This will help alleviate concerns expressed by several stakeholder groups.

Other: None identified.

Current Baseline Technology: While significant glovebox size reduction has not occurred on site to date, other sites have used manual methods employing extensive PPE and handheld saws and nibblers.

End-User: Fluor Hanford Inc. Nuclear Materials Stabilization Project.

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc., (509) 373-6622

Site Technical Point-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_Gibson@rl.gov

DOE End-User/Representative Point-of-Contact: Mark R. Hahn, DOE-RL, (509) 373-9872, Fax (509) 376-0695, mark_r_hahn@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TERMINAL CLEAN-OUT AND TRU WASTE DECONTAMINATION OF PFP

Identification No.: RL-DD03

Date: October 2000

Program: Nuclear Material Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: TRU Waste

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant (PFP)

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Terminal Clean-Out and TRU Waste Decontamination of PFP.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Techniques are needed to remove and stabilize kilogram quantities of plutonium that are held-up within PFP process systems. Process systems include, but are not limited to, glove boxes, piping, ducting, metal surfaces, and the Plutonium Reclamation Facility (PRF) Canyon floor.

Fast acting, low-life-cycle cost surface decontamination technologies, including those that can be remotely applied, are needed immediately. Surfaces include, but are not limited to, those found in glove boxes, piping, ducting, metal surfaces, concrete surfaces, etc. Ongoing decontamination activities require intensive manpower, produce secondary waste, and are costly.

Although they may involve differing quantities and concentrations of alpha-contaminated material, the basic materials to be cleaned are the same for both terminal clean-out and decontamination activities at the PFP.

Schedule Requirements:

Earliest Date Required: 09/2005

Latest Date Required: 09/2014

The completion of most stabilization activities occurs in early FY2005, and the terminal cleanout and D&D tasks will be initiated. These TCO and D&D tasks are scheduled to be completed to meet the final

milestone for PFP cleanout in FY2016. Early deployment of these technologies during the TCO and D&D periods will maximize the benefits obtained.

Problem Description: Contamination represents an immediate worker exposure concern as well as a long-term environmental concern. Many surface decontamination technologies generate secondary waste streams, are labor intensive, and are costly.

- a) **Glove Boxes** - Glove boxes have been used to handle radioactive materials for numerous activities. Present decontamination methods rely on personnel physically wiping surfaces. Worker fatigue and risk of exposure are inherent in these methods. Complete decontamination of glove boxes using these methods is difficult because many surfaces are difficult to access.
- b) **Piping and Ducting** - Plutonium exists in piping and ductwork in materials processing facilities. The current practice for removing and stabilizing plutonium in pipes and ductwork involves personnel physically cutting the materials, bagging them and transferring them to glove boxes for decontamination and size reduction. The process is time consuming, costly, and poses a risk of personnel exposure. Material removed must be managed as a transuranic waste, high-level waste, and/or low-level waste.
- c) **Metal Surfaces** - There are many metal surfaces that require terminal clean-out prior to final decontamination. These include the PRF Canyon floor, other metal floors, stainless-steel hot cell liners, cast iron slabs, lead bricks, heavy equipment, tank systems, etc. Contaminants include plutonium oxide, other transuranics, and variety of organic compounds. These surfaces will then require final decontamination.
- d) **Concrete Surfaces** - In addition to surface contamination, radioactive contamination associated with concrete surfaces may have penetrated to varying depths. Current practices include physical removal of the concrete surface (i.e., scabbling, sand blasting, etc.). Some contaminated concrete surfaces have been painted and/or coated with asphalt. Project requirements may require removal of such coatings prior to decontamination of the concrete.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Specific cost savings are not available since the baseline activities are not defined in detail. However, efficient decontamination techniques that minimize secondary waste production, and effectively segregate LLW and TRU, will provide significant (several tens of millions of dollars) savings versus more traditional methods.

Benefit to the Project Baseline of Filling Need: The achievement of the “slab on grade” decommissioning and decontamination goals for the PFP depends in large part on the effective use of these technologies. Both schedule acceleration and cost savings can be expected if innovative and effective decontamination tools are implemented.

Relevant PBS Milestone: TRP-14-401, Complete PFP Deactivation, 9/30/16

Functional Performance Requirements: Terminal clean-out decontamination methods are needed that minimize worker exposure, secondary waste generation, costs, risk and are readily deployable. Methods that clean to free-release levels are preferable. Specific applications include the following:

- a) **Glove Boxes** - The primary contaminant is plutonium oxide. Glove boxes contain multiple materials requiring decontamination such as glass, plastic, and metals in a variety of shapes and sizes. Many of these surfaces have restricted or difficult access.

- b) Piping and Ducting - The primary contaminant is plutonium oxide. A primary technology need is for improved methods for in situ decontamination in preparation for eventual removal.
- c) Metal Surfaces - The primary contaminant is plutonium oxide. Surfaces requiring clean-out include the PRF Canyon floor, steel flooring systems, stainless-steel liners, and a range of equipment items of varying size. Some surfaces will require in situ clean-out; others may be transported to a central decontamination facility following initial clean-out.
- d) Concrete Surfaces - The primary contaminant is plutonium oxide. The contaminant exists as 1) deposits of varying thickness throughout the concrete, 2) as surface contamination, and 3) as contamination contained on painted or asphalt-coated surfaces.

Work Breakdown Structure (WBS) No.: 1.4.5 – PFP

TIP No.: TRP-02-497

Justification For Need:

Technical: As facilities are transitioned to stable conditions and decommissioned, they require terminal clean-out and decontamination of radioactively contaminated materials. Current decontamination methods are often slow, costly, and produce secondary waste.

Regulatory: Completion of PFP terminal clean-out and waste removal.

Environmental Safety & Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Decontaminating materials to free release can minimize the volume of material destined for onsite burial. This will help alleviate concerns expressed by several stakeholder groups.

Other: None identified.

Current Baseline Technology: Current terminal clean-out techniques require intensive manpower, produce secondary waste (usually in the form of plutonium-bearing nitric acid), and are costly. The baseline technology is to flush the surface with dilute nitric acid, to wipe the surface (where accessible), to recirculate the solution (where feasible), to concentrate the solution by evaporation, and to convert the liquid to an impure powder suitable for storage. However, the presence of other compounds, such as tri-butyl phosphate, may lead to rapid exothermic reactions with the nitric acid cleaning solution during heating. Thus, alternative cleaning techniques are desired.

End-User: Fluor Hanford Inc. Nuclear Materials Stabilization Project.

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc., (509) 373-6622

Site Technical Point-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_gibson@rl.gov

DOE End-User/Representative Point-of-Contact: M. R. Hahn, DOE-RL, (509) 373-9872, Fax (509) 376-0695, mark_r_hahn@rl.gov.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TRU WASTE FIXATIVES FOR PFP

Identification No.: RL-DD04

Date: October 2000

Program: Nuclear Material Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: TBD

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant (PFP)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

- ☒ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: TRU Waste Fixatives for PFP.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Long-life fixatives that can contain dispersible radioactive materials that are easily applied to and removed from surfaces are needed. Such fixatives could be used on a variety of surfaces such as those encountered in materials processing facilities, glove boxes, and ductwork.

Schedule Requirements:

Earliest Date Required: 09/2005

Latest Date Required: 09/2014

Although schedules are not firm, initial selection of the technology should occur in early 2002. Deployment may occur through 2014.

Problem Description: Dispersible surface contamination is present in materials processing facilities. Such dispersible contamination often presents health risk to the worker and potential environmental concern. In areas where decontamination is not feasible, dispersible contamination is fixed in place.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: None defined at this time; baseline technologies have not been selected.

Benefit to the Project Baseline of Filling Need: Achieve terminal cleanout and D&D tasks effectively and at minimum cost.

Relevant PBS Milestone: TRP-14-401, Complete PFP deactivation, 9/30/16

Functional Performance Requirements: The fixative may be used to contain dispersible alpha contamination. The fixative must be easily removable to allow for eventual decontamination. It needs to last 20 to 25 years, and a thin film is preferred. Deployment of a two-phased fixative technology is acceptable: (1) long-term fixative; (2) stripper that easily removes the long term fixative.

Work Breakdown Structure (WBS) No. : 1.4.5 - PFP

TIP No.: TRP-02-497

Justification For Need:

Technical: Dispersible radioactive contamination can present safety/exposure concerns.

Regulatory: Completion of PFP terminal clean-out and waste removal

Environmental Safety & Health: Dispersible radioactive contamination can present safety/exposure concerns.

Cultural/Stakeholder Concerns: Employee and public exposure to radioactive materials is a concern of Hanford Site stakeholders.

Other: None identified.

Current Baseline Technology: Paint, tar, polymeric barrier systems, rustoleum.

End-User: Fluor Hanford Inc. Nuclear Materials Stabilization Project.

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc., (509) 373-6622

Site Technical Point-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_Gibson@rl.gov

DOE End-User/Representative Point-of-Contact: Mark R. Hahn, DOE-RL Material Disposition Division (509) 373-9872, Fax (509) 376-0695, mark_r_hahn@rl.gov

DEACTIVATION

BUILDINGS 324 AND 327

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CHARACTERIZATION OF BUILDINGS 324 AND 327

Identification No.: RL-DD05

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford

PBS No.: RL-RC06

Waste Stream: Mixtures of contaminated and non-contaminated equipment and materials from within hot cells and supporting systems. The material and equipment may include radioactive/mixed wastes, hot cell equipment, ventilation equipment, tanks, pipes, cell construction materials, etc.

TSD Title: N/A

Operable Unit (if applicable): N/A.

Waste Management Unit (if applicable): N/A.

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Characterization of Buildings 324 and 327

Need/Opportunity Category: *Technology Opportunity* -- The Site desires alternatives to the current or planned baseline technology/process (e.g., a baseline technology exists but can be improved).

Need Description: Characterization technologies are needed for real-time or near real-time, in-situ determination of contamination levels. Differentiation between TRU waste and (non-TRU) waste is a primary concern. In addition, a verifiable method for determining that materials, components and equipment qualify for free release, or are sufficiently decontaminated to support deactivation end-point criteria is necessary.

Schedule Requirements:

Earliest Date Required: (01/2002)

Latest Date Required: (09/2007)

Problem Description:

- a) Ducts/Piping - In situ characterization techniques are needed for assessing contamination within ducts and piping. In many instances, the ducts and piping are highly contaminated and may have in-line obstructions. Access also presents challenges due to small diameters, tees, ells and combined vertical/horizontal runs.
- b) Remote Radiation Mapping - It is difficult to determine where contamination hot spots are in high radiation areas (radiation levels on the order of 2,000-5,000 R/hr in hot cells and ducting). A method that would provide point-specific information is desired to optimize decontamination

resources. Current methods for obtaining these data are labor intensive, long in duration, wasteful of personnel occupational radiation exposure, expensive, and subject to a variety of random and systematic errors caused by the use of multiple performers taking repetitive measurements over rather extended time periods.

- c) Segregation techniques – Techniques are needed that can differentiate between radioactively contaminated and uncontaminated equipment and materials. Potentially contaminated surfaces are often inaccessible to current detection methods. Some materials are managed in their entirety as radioactive and/or mixed wastes, which add unnecessary costs for handling and disposal.
- d) Verification - To ensure Facility Endpoint Criteria are satisfied, measurement of remaining contamination must be quantified. It is difficult to provide accurate, verifiable data when large areas/equipment is involved.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: ROM LCCS are conservatively estimated at \$300K for near-term characterization tasks. This is based on an assumed characterization budget of \$500K for six years, and a 10% improvement in efficiency. Also, cost savings during long-term surveillance and maintenance may be realized by confidently mapping radiological areas at the end of deactivation. Cost savings should also be realized from improved segregation techniques and from less conservative waste packaging and disposal requirements; assignment of specific cost savings values for these aspects would be speculative at this time.

Benefit to the Project Baseline of Filling Need: Benefits realized by the Projects should include characterization task efficiencies/schedule reduction, waste volume/class reduction and the reduction in associated disposal costs. Dose reduction and ALARA-based improvements should also be realized.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: A method is needed that will allow for real-time differentiation between TRU and non-TRU waste, between low-level waste and free-release waste and/or provide quantitative assessment of remaining contamination. Characterization is required for a variety of configurations including walls, ceilings, equipment, hot cells, and hot cell support equipment.

- a) Ducts/Piping - Improvements are needed for the remote, in situ characterization of contamination levels in ducts and piping. Ductwork may have obstructions and limited access. Contaminants include cesium, strontium, uranium, and transuranics. The technology would need to be adaptable to a variety of configurations.
- b) Remote Radiation Mapping - Remotely deployable radiation mapping techniques are required. Methods should permit the identification of hot spots within an area containing high radiation levels.
- c) Segregation Techniques - Techniques are needed that can differentiate between contaminated and non-contaminated material, and for equipment that has inaccessible surfaces. Current technology allows crushed material on the order of 1 inch or less to be segregated through the assay of the material on a conveyor belt. The improved technology should permit the real-time characterization of materials larger than crushed materials.

- d) Verification – Facility Endpoint Criteria limit the amount of contamination that can remain in the facility for long-term surveillance. Techniques are needed to provide accurate, verifiable measurement of the remaining contamination on large surfaces and equipment.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-03-901, Select Technologies for Characterization and Removal of Contaminated Piping, June 27, 2003

Justification for Need:

Technical: Adequate characterization will be used to perform the Final Hazards Analysis prior to completing deactivation end points.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Supports as low as reasonably achievable (ALARA) and radiological mapping for future decontamination and decommissioning (D&D) efforts.

Cultural/Stakeholder Concerns: Reduce employee exposure to toxic and/or radioactive materials. Better characterization data will lead to better and more cost-effective decontamination/removal decisions, thus minimizing quantities of materials handled, stored, or disposed of as a waste product.

Other: None identified.

Current Baseline Technology: Wipes, laboratory samples, radiation detection – both general and energy-specific such as the gamma spectral analyses, document searches, physical walk-through, visual inspections and data recording, hand-held or cart-mounted survey equipment, and ad hoc sampling of representative surfaces, materials, and spaces. Segregation activities involve the use of any of these techniques or material equipment is managed as contaminated.

End-User: EM-60.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov)

DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: (509) 372-3508, [David T Evans@rl.gov](mailto:David_T_Evans@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DECONTAMINATION OF BUILDINGS 324 AND 327

Identification No.: RL-DD06

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Various equipment and material surfaces with alpha, beta, and gamma contamination that is 1) dispersible, 2) fixed, and/or 3) embedded

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Decontamination of Buildings 324 and 327

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: Fast acting, low-life-cycle cost surface decontamination technologies, including those that can be remotely applied are needed immediately. Surfaces include, but are not limited to, those found in hot cells, piping, ducting, concrete basins, metal floors, walls, and ceilings. Ongoing decontamination activities require intensive manpower, produce secondary waste, and are costly.

Physical decontamination methods, especially those based on UHP water jets (i.e., scarification) are being considered for the 324 Facility. This system would be deployed within large hot cells to clean stainless steel, cast iron surfaces and AmerCoat painted surfaces. Application of these methods is primarily to larger surface areas such as 23ft x 30ft wall areas.

A separate need exists for limited area cleaning (i.e., spot cleaning). The overall plan is to use physical methods for larger areas to remove bulk activity. Complex shapes and crevice areas (e.g., hot cell manipulator ports, seal plugs, gasket-sealed viewing windows) that lead to the exterior of the cell must be cleaned by other techniques (e.g., chemical foams, gels, small geometry vacu-blasters [media recovery by vacuum equipment], or possibly laser ablation).

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/30/07)

Problem Description: Contamination represents an immediate worker exposure concern as well as a long-term environmental concern. Many surface decontamination technologies generate secondary waste streams, are labor intensive, and are costly.

The 324 and 327 facility hot cells and supporting areas have a radioactive inventory that is highly variable, depending on the type of development work that was performed in the cells. For example, the 324 B-Cell processed large amounts of concentrated fission products (Cesium 137 and Strontium 90), while the 324 D-Cell processed wasted tank material and preformed fuel pin cutting (depositing transuranic isotopes).

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A detailed, Net Present Value LCCS of \$3.6M was estimated in a recently published ASTD proposal ("Remote Dry Media Blasting for Hot Cell Facility Cleanout/Decontamination," dated March 2000). This proposal was directed for use at Hanford's 324 and 327 Buildings. Cost savings to result from deployment of such a system were based on: 1) reduced size, complexity, and throughput requirements for the baseline liquid waste treatment and processing skids; 2) reduction in the amount of Radioactive Liquid Waste (RLW) which would be transported to and disposed of at the 200 Area Tank Farms; and 3) reduced RLW processing and treatment time/resources. The 324 Facility is presently considering in-cell evaporation for reduction of wastewater volumes, so the \$3.6M savings may be slightly reduced if this waste handling method is selected. The factors included in the estimate for the 327 Facility contribution would, however, remain unchanged.

Benefit to the Project Baseline of Filling Need: Benefits to be realized by the Projects should include decontamination task efficiencies/schedule reduction, waste volume/class reduction and the reduction in associated disposal costs. Dose reduction and ALARA-based improvements should also be realized. Certain spot cleaning techniques, or methods for cleaning hot cell through ports (e.g., hot cell manipulator ports, seal plugs, gasket-sealed viewing windows) or segmented structures (e.g., 327 facility hot cells) may be viewed as enabling technologies.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: Decontamination methods are needed which minimize worker exposure, secondary waste generation, costs, and risk and are readily deployable. Methods that clean to free-release levels are preferable. The 324 Building hot cells typically contain stainless steel and carbon steel liners over a concrete base. Contaminants may be restricted to the surfaces of these liners but also may have penetrated the stainless steel and concrete to varying depths. Surfaces requiring decontamination include concrete cell walls, steel flooring systems, stainless steel liners, and a range of equipment of varying size. Some surfaces will require in situ decontamination; others may be transported to a central decontamination facility. The primary contaminants include strontium and cesium, but may also include uranium and transuranic waste from spent fuel. Radiation levels range from 2,000 R/hr general area to 7-10,000 R/hr hot spots. Waste minimization and remote handling methods are of prime importance.

The goal of the decontamination method should be to achieve a level of cleaning such that the 324 Building can be reduced from "Nuclear Hazard Category 3" to "Radiological Facility" status (per DOE-STD-1027). Nuclear Hazard Category 3 threshold values for predominant isotopes in the 324 and 327 Facilities include Cs-137 at 60 Ci, Sr-90 at 16 Ci, Pu-239 at .52 Ci, and Am-241 at .52 Ci. A sum-of-fractions technique is used to address the multiple-isotope source term per DOE-STD-1027 ("Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear

Safety Analysis Reports”) allows for “segmentation” of a facility when a common accident cannot involve the entire facility inventory.

High contamination areas should also be cleaned to a level that will allow the use of fixatives if residual contamination remains (i.e. < 100k dpm). A combination of decontamination/fixative products and methods may be used. Initial cleaning will be remotely deployed; later work will be performed semi-remotely or via contact methods once the fields are sufficiently reduced. Active ventilation may be terminated after cleaning.

The overall goal is to maximize the use of physical methods and supplement them with minimal chemical or other methods that would be used as spot cleaners. By limiting the chemical use, the waste volumes will be considerably reduced.

Within B Cell, the crane rail area, the shield window apertures, service plug apertures, slit trench, and pocket sump areas must be cleaned. Within 327 Facility, 10 hot cells, dry storage, and wet storage basins are areas that must be decontaminated. The secondary waste should be limited because TRU constituents are involved. The objective is to avoid spreading the contamination to previously cleaned areas. In most cases, vacuum recovery systems will be needed to collect the radionuclide materials.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-04-902, Select Technologies for Duct Cleaning and Removal, April 15, 2003

Justification for Need:

Technical: As facilities are transitioned to stable conditions and decommissioned, they require decontamination of radioactively contaminated materials. Current decontamination methods are often slow, costly, and produce secondary waste.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Decontaminating materials to free release can minimize the volume of material destined for onsite burial. This will help alleviate concerns expressed by several stakeholder groups.

Other: None identified.

Current Baseline Technology: Concrete - scabbling, hydro-lancing; Metal - wipes, hydro-lancing, ice blasting, steam, acid washes, electro polishing; Glove boxes - wipes, strippable coatings/gels.

End User: EM-40.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH), (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, Gregory_T_Berlin@rl.gov.

DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: (509) 372-3508, David_T_Evans@rl.gov.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIXATIVES FOR BUILDINGS 324 AND 327

Identification No.: RL-DD07

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: N/A - Radioactively contaminated surfaces with loose or dispersible contamination

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Fixatives for Buildings 324 and 327.

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: Long-lived fixatives that are easily applied to, and (in some cases) removed from, surfaces are needed to immobilize radioactive materials. Fixatives will be needed for a variety of surfaces such as those encountered in materials processing facilities, glove boxes, hot cells, tanks and tank vaults, and ductwork.

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/7/07)

Fixatives may be deployed from 2002 through 2007.

Problem Description: Dispersible surface contamination is present in hot cell facilities. Such dispersible contamination often presents a worker exposure concern and a long-term environmental concern. In areas where decontamination is not feasible, dispersible contamination is fixed in place. At present, long-term performance of commercially available fixatives under radiation fields is not well understood.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A ROM estimate of LCCS due to the application of improved fixatives is \$400-500K. This estimate is preliminary, and assumes similar application costs for baseline versus improved fixatives. Savings should result from the

need for less-frequent applications, efficiencies gained through ALARA measures, and a reduction in the degree of decontamination required prior to size reduction and/or packaging of waste materials.

Benefit to the Project Baseline of Filling Need: Effective use of fixatives supports ALARA practices and results in a more controlled and safer and more efficient environment for workers. Other expected benefits are noted in the paragraph above.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: The fixative may be used to immobilize dispersible alpha, beta, and gamma contamination. In some situations, the fixative may need to be easily removable to allow for eventual decontamination. Thin-filmed fixatives with a 20-25 year life are preferred. A two-phased fixative would be acceptable: 1) long-term fixative and 2) stripper that easily removes the long-term fixative. Flammability ratings before, during and after mixing of multi-component fixatives may be a concern for certain application.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: Dispersible radioactive contamination can present safety/exposure concerns.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Dispersible radioactive contamination can present safety/exposure concerns.

Cultural/Stakeholder Concerns: Employee and public exposure to radioactive materials is a concern of Hanford stakeholders.

Other: None identified.

Current Baseline Technology: Paint, tar, polymeric barrier system, rustoleum.

End User: EM-40.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov).

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE CUTTING TECHNOLOGIES FOR BUILDINGS 324 AND 327

Identification No.: RL-DD08

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated materials, equipment, tanks, pipes, gloveboxes, and ducting. Asbestos contaminated materials also require cutting.

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote Cutting Technologies for Buildings 324 and 327

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: Low life-cycle cost cutting technologies are needed immediately for size reduction of radioactively contaminated materials, equipment, tanks, racks, pipes, etc. Many situations will require remote cutting capabilities using master-slave manipulators (MSMs), robotics arms or overhead cranes for deployment.

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/30/07)

Problem Description: Deactivation requires removal and size reduction of a variety of equipment and materials. Radiation concerns often prevent direct access. Current methods are time consuming, generate secondary waste, cause a high degree of worker fatigue, and are costly.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A LCCS of \$4.3M was estimated in a recently published ASTD proposal (“Laser Cutting System for Hot Cell Liner and Tank Size Reduction,” dated March 2000). This estimate was based on specific tasks for removal of cell liners, high-and low-level vault piping, and tanks within the 324 Facility. The cost benefit analysis was based on a 50% reduction in time required to accomplish cell liner removal, and a 20% rate increase for all other cutting tasks in the 324 Facility. Additional savings may be realized from application in the 327

Facility as well as from size reduction of gloveboxes in Hanford's 308 Building.

Benefit to the Project Baseline of Filling Need: Primary benefits to the project include increased task efficiencies and associated schedule reduction, improved ability to segregate waste via selective removal of "hot-spot" material sections, and personal dose reduction due to cutting speed improvements and remote application.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: The equipment should be easily set up, be reliable, have capability for remote operations, and have little or low generation of dust or other secondary waste. The methods should operate faster than the currently used methods. Technology may be deployed by crane in locations having high radiation fields (2,000 to 5,000 R/hr). Most of the contaminated equipment is in hot cell locations where only cranes and/or manipulators are available for operations. Equipment requiring cutting in the hot cell environments include items with complex geometries, such as equipment racks, fuel racks, pipes, tanks, and hot cell liners.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: Current methods are often too slow and labor intensive. High radiation levels prevent direct worker access equipment or materials requiring size reduction.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Occupational concerns in dealing with hot cells and materials with high levels of radioactive contamination.

Cultural/Stakeholder Concerns: Stakeholders have expressed concerns with regard to the amount of waste destined for burial at the Hanford Site and about the ultimate disposition of large processing facilities and reactors. Effective size reduction efforts can minimize waste volumes and help facilitate decontamination efforts. Size reduction of waste helps facilitate the removal of radioactively contaminated materials and equipment.

Other: None identified.

Current Baseline Technology: Metal - plasma torch, hydraulic shears, hacksaws, oxygen-acetylene torch, diamond saws, circular saws; glove boxes - nibblers and shears.

End User: EM-40.

Contractor Facility/Project Manager: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov).

DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: 372-3508, [David T Evans@rl.gov](mailto:David_T_Evans@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TANK REMEDIATION FOR BUILDING 324

Identification No.: RL-DD09

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Processing tanks in 324 High-Level Vault (HLV) and Low-Level Vault (LLV)

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Building 324

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Tank Remediation for Building 324.

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: Methods are needed for characterization, decontamination and/or stabilization, size-reduction and/or removal of HLW and LLW tanks located in below-grade vaults.

Schedule Requirements:

Earliest Date Required: (02/08/02)

Latest Date Required: (01/30/03)

Problem Description: One of the major sub-projects required for deactivation of Hanford’s 324 Facility involves the removal and disposal of four tanks located in the 324 high-level vault (HLV). Over the past several decades, radiochemical waste researchers used these tanks (T-104, T-105, T-106 and T-107) to support the development and demonstration of chemical and thermal treatment processes. These tanks have limited access, with all pipes having welded connections. Tank T-105, which contains about 70% of the total curie inventory of waste in the vault is located directly beneath the 6-ft-thick, concrete shielding cover/access blocks, and has a very high source term estimated to be 10,000 curies of Cesium 137/Barium 137 with an estimated equivalent amount of Strontium 90/Yttrium 90. The present Project Management Plan (PMP) specifies that Tank T-105 must be emptied and removed before the rest of the HLV tanks can be deactivated. Based upon this approach, the deactivation of Tank T-105 presents the following challenges:

- Inspection – cameras or other imaging equipment must be deployed in the tank to view the internals and the suspected waste heel

- Radiation Monitoring – characterization and dose profiling equipment must be deployed in the tank for data collection
- Sampling – samples from various locations within the tank may need to be retrieved and analyzed
- Decontamination – waste contents should be removed or fixed/stabilized prior to tank removal and size reduction
- Removal – tank T-105 must be removed to gain access to the remaining three tanks in the HLV

Tanks in the 324 Low-Level Vault present similar challenges. A similar need is also documented for Hanford's 340 Vault tanks – See Need RL-DD082.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The current baseline cost for HLV tanks remediation activities is estimated at \$2.7M. While technology options studies to support the tank remediation were initiated in FY00, the baseline plan requires specific definition of workscope and technologies to be completed in FY 2003. Simply assuming a 10% efficiency in the current baseline cost assumptions would yield a \$270K cost savings.

Benefit to the Project Baseline of Filling Need: Decontamination or removal of the HLV tanks would eliminate a significant source term within the 324 Facility.

Relevant PBS Milestone:

TRP-06-921	324 Deactivation Complete	September 22, 2006
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Functional Performance Requirements: Remote techniques are needed to remove tank heels or prevent dispersion of contamination on cutting or disassembly. The residual material ranges from low-level to high-level material with potential for TRU waste. The residues are in the form of liquids, liquid sludges, solids and dispersible material.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-04-904, Select Technologies for Highly Contaminated Tank Removal in 324, February 8, 2002

Justification For Need:

Technical: The closure plan for the facility requires removal of the tanks. Reduction of the radiological fields because of the residual heels will be required to allow for size reduction and removal.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005.

Environmental Safety & Health: There are potential worker safety concerns associated with exposure during removal operations.

Cultural/Stakeholder Concerns: N/A. Required prior to closure.

Other: None identified.

Current Baseline Technology: Specific technologies have not been selected, however, the current baseline includes tank and piping integrity assessments followed by system flushing, decontamination and either in-situ size reduction or whole tank removal.

End-User: EM-40.

Contractor Facility/Project Manager: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov).

DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: 372-3508, [David T Evans@rl.gov](mailto:David_T_Evans@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

RADIATION HARDENED ROBOTICS FOR BUILDINGS 324 AND 327

Identification No.: RL-DD010

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-TP08

Waste Stream: Highly radioactive materials within hot cells and support areas

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|---|

Need Title: Radiation Hardened Robotics for Buildings 324 and 327

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: Remote handling methods are needed for performing deactivation tasks in the 324 and 327 hot cells and supporting areas. Remote systems are needed to characterize contaminated areas and to deploy decontamination, stabilization and cutting technologies. To support the automated systems, appropriate remote tooling (end-effectors) must also be identified and procured for use with the robotic or remote systems.

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/07/07)

Piping and sludge removal from the 324 Air Lock Pipe Trench will begin in mid FY 2001 and is scheduled for completion in late FY 2001. Robotic systems will be needed on a nearly continuous basis in Buildings 324 and 327 to support cell decontamination, cell liner inspection, and repair/or liner removal, characterization, size reduction, etc.

Problem Description: Cleanout of hot cell, pipe trench, vault and supporting areas in the 324 and 327 Buildings require the decontamination, dismantling, and removal of equipment and debris. Activities are best performed remotely because of the high-radiation fields. In some cases, overhead cranes are the only equipment available to perform work; in other areas, master-slave manipulators (MSMs) are the only currently available access mechanism. Cranes often prove to not have the fine motor control necessary to

accomplish a given task. MSMs also have limited reach and payload. Both crane systems and MSMs are experiencing high failure rates due to the stress demands of deactivation tasks. Remote cutting operations are often tedious and labor intensive, which can lead to worker fatigue and potential for dropping equipment and other failures.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: ROM estimates of LCCS that may be realized at the 324 and 327 Buildings from deployment of proper robotic systems have been estimated to be at least \$5-10M. A recently published ASTD Proposal ("Teleoperated Remote Replacement for Mechanical Master Slave Manipulators" dated March 2000) documented a potential savings of \$2.2M for the deployment of just one robust arm to supplement the existing inventory of MSMs in 324 during the period of 2001-2004. Additional arms and robotic systems for other remote applications would substantially increase the savings potential for the FY 2001-2007 work scope in Buildings 324 and 327.

Benefit to the Project Baseline of Filling Need: In some areas of Buildings 324 and 327, a new robotic system may be considered as an enabling technology due to the fact that no operating equipment is presently available to initiate work. For example, an inoperable overhead crane in a high radiation area in 324 Building requires repair but cannot be reached with existing MSMs. Other benefits of deploying robotic systems in 324 and 327 Buildings include reduction of downtime associated with MSM failures, reduction of personnel risk from exposure and contamination, and improved operating efficiencies and performance schedules.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: Remote systems must be able to perform remote activities requiring a range of motions and weight requirements in high-radiation fields (on the order of 2,000 to 5,000 R/hr) and with a life expectancy greater than 1 year. Systems appropriate for the 327 Facility must be deployable through existing hot cell shield plug holes (approximately 8 inches in diameter). The associated tooling may be operated pneumatically, hydraulically, or electrically, but must be able withstand the harsh environments of the hot cells. Specialized tooling must be compatible with the current inventory of robotic systems.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.:

TRP-01-901, Select Technologies for 324 Hot Cell Liner Integrity Assessments, April 27, 2003
 TRP-03-901, Select Technologies for Characterization and Removal of Piping in 324, June 27, 2003
 TRP-04-904, Select Technologies for Highly Contaminated Tank Removal in 324/327, February 8, 2002

Justification for Need:

Technical: Activities in high-radiation areas require remote operations.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Worker safety, exposure, and fatigue are the primary concerns.

Cultural/Stakeholder Concerns: Worker exposure can be significantly reduced by using remotely deployed systems that avoid putting workers at risk. The location of the 324 and 327 Buildings in proximity to the Columbia River and the Richland City limits increases stakeholder interest in the reduction of nuclear facility source terms.

Other: None identified

Current Baseline Technology: Overhead bridge cranes and master slave manipulators

End User: EM-40.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

STRUCTURAL INTEGRITY INSPECTION -- 324/327 BUILDINGS

HOT CELL LINERS

Identification No.: RL-DD011

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactive, stainless steel hot cell liners

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Structural Integrity Inspection Technologies - 324/327 Buildings Hot Cell Liners.

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: A method is required for the reliable inspection of the integrity of stainless steel, hot-cell liners to support the selection of an appropriate method for decontamination. Among others, thermal imaging, x-ray and ultrasonic technologies may prove useful.

Schedule Requirements:

Earliest Date Required: (04/30/02)

Latest Date Required: (09/07/07)

Problem Description: Penetration through and/or cracking of the hot cell liners may have resulted from past operations. Demonstration of integrity (or lack thereof) is a Closure Plan requirement, and influences the need for any liner repair prior to liner decontamination.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: N/A – At this stage, potential cost savings might be postulated based on an assumed leak, selection of inappropriate decontamination techniques, etc. Such failure-focused assumptions hold little value.

Benefit to the Project Baseline of Filling Need: Information gained from proper selection and use of NDE equipment will provide confidence in the decision to initiate decontamination tasks and select the proper

decontamination methods. NDE data may also reveal liner regions that should be repaired or fortified prior to cleaning.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: The hot cell liners are composed of 1/8-inch 304 stainless steel that has been welded into one piece. The cell liners must be thoroughly examined for cracks and other potential leak points. The technology must be able to withstand a radioactive environment, be remotely deployed, and must be able to operate in a variety of orientations and positions.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-01-901, Select Technology for 324 Cell Liner Integrity Assessment, April 27, 2003

Justification For Need:

Technical: Decisions with regard to the decontamination method to be used are influenced by the integrity of the liners. Simple, accurate methods to verify the integrity of such liners can positively influence these decisions.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety & Health: Contamination release to the environment must be prevented – see comment below (Cultural/Stakeholder Concerns).

Cultural/Stakeholder Concerns: Stakeholders are concerned about releases to the environment. Liner systems are often a primary barrier between any given source and the environment. Verifying the integrity of such liner systems can help alleviate such concerns.

Other: None identified.

Current Baseline Technology: Remote visual and camera inspection.

End-User: EM-40.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

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DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: (509) 372-3508, [David T Evans@rl.gov](mailto:David_T_Evans@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CLEAN-OUT OF ISOLATED PIPING SYSTEMS IN BUILDING 324

Identification No.: RL-DD046

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated piping

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Building 324

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|---|

Need Title: Clean-out of Isolated Piping Systems in Building 324.

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: Methods are needed to perform the decontamination of individual pipes, piping systems and tanks that are inaccessible because they are either in a high-radiation area, an enclosed pipe chase or vault and/or they are encased in concrete.

Schedule Requirements:

Earliest Date Required: (06/27/03)

Latest Date Required: (09/22/06).

Problem Description: Methods to ensure adequate decontamination of isolated piping systems have not been proven. These methods should not have the potential to disperse contamination from any potential leaks. Approximately 100 individual pipes route from the Building 324 hot cells to waste vaults, many of which are encased in concrete or enclosed within pipe chases. Pipe diameters range from 0.5 to 2 inches.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: An initial, ROM estimate of LLCS has been set at \$200K. This value is simply based on a 50% reduction in the amount of flush water requiring treatment. Assuming 100,000 gallons of decontamination solutions will be generated from all cleaning efforts in 324, and that 20,000 gallons are to be generated from pipe flushing; a 50% reduction in pipe flushing liquids will yield a savings of 10,000 gallons due to the improved cleaning techniques. Assuming a handling and treatment cost of \$20/gallon yields a cost savings of \$200K.

Benefit to the Project Baseline of Filling Need: Assumed benefits include improved efficiency and schedule reduction, minimization of secondary waste, and a reduction in risk of exposure to personnel exposure or contamination to the environment.

Relevant PBS Milestone:

TRP-06-921 324 Deactivation Complete September 22, 2006

Functional Performance Requirements: The technology, technique, or methods must be acceptable for use and concurred with by the Washington State Department of Ecology and the DOE.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-03-901, Select Technologies for Characterization and Removal of Contaminated Piping in Building 324, June 27, 2003

Justification For Need:

Technical: Piping systems must be cleaned to meet facility closure plan requirements and to reduce holdup/inventory.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005.

Environmental Safety & Health: An aqueous-based decontamination method could result in contamination release to the environment if a leak is encountered.

Cultural/Stakeholder Concerns: Stakeholders are concerned about releases to the environment. The 324 building is located within 1,000 feet of the Columbia River.

Other: None identified.

Current Baseline Technology: Current practice is to test a system for leaks, flush it repeatedly with a cleaning solution such as water, and analyze samples of the rinse to validate compliance with regulatory requirements. This practice is time consuming and does not easily guarantee that the level of remaining contamination is acceptable.

End-User: EM-40.

Contractor Facility/Project Manager: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov)

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE VIEWING FOR HOT CELLS AND ASSOCIATED AREAS IN BUILDINGS 324 AND 327

Identification No.: RL-DD047

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote Viewing for Hot Cells and Associate Areas in Buildings 324 and 327

Need/Opportunity Category: *Technical Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Technologies, techniques, and methods are needed to provide low-cost upgrades to improve the remote visibility in hot cells, ventilation ducting, piping and other difficult to reach areas. Upgrades would provide hot cell operators with improved control and the ability to expedite work activities. Equipment for remote deployment in tanks, ducts and piping would also provide useful data for assessing waste deposit/heel location, physical characteristics and remediation options.

Schedule Requirements:

Earliest Date Required: (10/01/03)

Latest Date Required: (09/30/07)

Problem Description: The presently deployed remote camera systems in hot cells provide medium-resolution, black and white or color imaging and do not reach all hot cell regions. Improved optics could ease the planning and execution of hot cell dismantlement activities. Systems offering a combined wide/narrow field could prove useful.

Also, a number of tanks within the 324 Facility have no vertical riser access. If commercially available, visual inspection of the tank internals may be possible by “snaking” very small diameter (i.e. < ½-inch) cameras/scopes through roughly 50 feet of piping with ells and tees along the routing. Negotiation of small radius ells and tees present a challenge.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Improved visibility should allow for remotely controlled cleanup activities to be accomplished at a higher rate and with finer control. A ROM estimate for LCCS simply based on task efficiencies from improved viewing capability alone would likely exceed \$250K. Additional savings would most certainly be realized from application of better knowledge on location and visual/physical characteristics of waste holdup.

Benefit to the Project Baseline of Filling Need: As noted above, benefits would be gained from increased deactivation task efficiency, possibly from better waste segregation and the resulting decrease in waste disposition costs, and minimize risk/exposure to workers from better knowledge of holdup location.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: It is desired to upgrade the existing systems to a high-resolution, color imaging system and to provide visibility to all areas within a hot cell. The system must be able to function in an environment containing high levels of radiation (2,000 to 5,000 R/hr) and chemical contamination, and provide remote viewing from up to 75 feet outside of hot cells.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: Operational improvements are needed to support hot cell cleanout.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Enhanced visibility into the 324/327 hot cells will enable better identification of materials within individual cells. Knowledge of the contents will enable personnel to better plan for the safe, efficient remediation of these areas. Improved visibility will also help to reduce the chances of exposure to personnel.

Cultural/Stakeholder Concerns: Stakeholders are concerned about releases to the environment. The 324 and 327 buildings are located within 1,000 ft of the Columbia River.

Other: Improved camera systems can be transferred to other facilities and applications.

Current Baseline Technology: The hot cells currently use a minimal number of black and white and color, radiation hardened, video cameras. No systems are yet known to be commercially available and able to negotiate the small diameter piping with ells and tees along its routing.

End User: EM-60.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov).

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DUCT CLEANING FOR BUILDINGS 324 AND 327

Identification No.: RL-DD077

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated ventilation ducting

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Duct Cleaning for Buildings 324 and 327

Need/Opportunity Category: *Technical Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Systems are need to remove radioactive, dispersible contamination from ventilation exhaust ducting systems in Buildings 324 and 327. The 324 Facility ducting is mostly comprised of 24 inch-diameter, ¼ inch, 304-L grade stainless steel. The 324 D-Cell ducting is rectangular, measuring 11 x 22 inches. Ducting in the 327 Facility is commonly 11 inches in diameter.

Schedule Requirements:

Earliest Date Required: (10/01/02)

Latest Date Required: (01/19/07)

Problem Description: The 324 and 327 facility hot cells have inventory that is highly variable depending upon what type of development work was performed in the cell. Large sources of semi-mobile material cannot be left in the facility following facility closure or transition. Two of the 324 hot cells have substantial inventory of transuranic isotopes and fission products. The B cell has processed large amounts of concentrated fission products (Cesium 137 and Strontium 90) and has high levels of contamination both in the cell and in the exhaust duct. The ducting is comprised of 24-inch diameter, 304 stainless steel material. The 324 D-Cell has processed waste tank material and has housed the cutting of fuel pins, which generate transuranic isotopes. D-Cell duct levels are unknown. A duct survey is needed to provide real inventory data. Material in the 327 Facility ducting is not expected to be significantly “fixed.” Methods should then be established removal of the material as required. If inventory is large, then removal toward the hot cell may present the best option. If the inventory is limited, then the cleaning

process can release material to the downstream filters (A-frame). Duct cleaning technologies should be evaluated in terms of decontamination factor and waste volume. Duct cleaning will be done late in the hot cell decontamination process, and may require isolation of the exhaust duct.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Potential Cost savings are TBD at this time. Cost analyses can be performed once technology baseline and options are better established. Duct remediation option studies are planned for FY 2001-2002.

Benefit to the Project Baseline of Filling Need: Satisfaction of need will support ability to reach deactivation end states and provide readiness for D&D.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: Systems must remove debris in ducting, leaving only fixed contamination. Cleaning process may be aqueous or dry (dry system is preferred for 327 facility ducting). Vacuum recovery of the debris will be necessary at the duct inlet or out, depending on Curie levels.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-04-902, Select Technologies for Duct Cleaning and Removal, April 15, 2003

Justification For Need:

Technical: As facilities are transitioned to stable conditions and decommissioned, they require decontamination of radioactively contaminated materials.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Decontaminating materials to free release can minimize the volume of material destined for onsite burial. This will help alleviate concerns expressed by stakeholder groups.

Other: None identified.

Current Baseline Technology: CO2 blasting, media blasting, water lasers, UHP water and mechanical scarification.

End-User: EM-40

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov).

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED VACUUM RECOVERY SYSTEMS FOR BUILDINGS 324 AND 327

Identification No.: RL-DD078

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactive dispersibles on or within hot cell construction materials, ducting, tanks, vault floors etc.

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

☒	1. Critical to the success of the ACPC
☐	2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
☐	3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved Vacuum Recovery Systems for Buildings 324 and 327

Need/Opportunity Category: *Technical Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Vacuum recovery systems will be needed to collect dry and wet solids during the course of cleaning several areas in the 324 Building. These areas include the floors of B cell, D cell, high-level vault, SMF, and the hot pipe trench. Vacuum systems may also be needed during size reduction of the HLW and LLW vault tanks. It is also probable that the B cell exhaust duct inventory will be transferred back to B cell with a vacuum system. Radiation fields vary significantly as does working space. In most cases, the change-out of the vacuum filters will be remotely performed using master-slave manipulators (MSMs). The need for similar application exists for 327 facility hot cells and supporting area, however the decontamination and recovery systems will be predominately dry.

Schedule Requirements:

Earliest Date Required: (01/01/01)

Latest Date Required: (09/30/07)

Problem Description: Several zones in SMF, 324 hot cells, and the 327 Facility will require the collection of dry solids and combined water and solids. Contaminated debris will be generated from media blast cleaning, HP and UHP water cleaning and possibly dry scrubbing equipment.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD -- No savings can be noted at this time. Decontamination and waste recovery methods will be assessed in FY 2001-FY 2002.

Benefit to the Project Baseline of Filling Need: Vacuum recovery system will help to minimize airborne dispersible material and provide rapid capture of particulates, thus reducing risk to workers. Such systems are also expected to be much more efficient than mechanical removal systems, thus potentially reducing task schedules.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: A variety of vacuum recovery systems are needed for removal of potentially dispersible, radioactive debris and particulates from within hot cells, ducting, tanks, vaults and pipe trenches. Modular units must be designed for easy installation, assembly, electrical connection, and filter/canister change-out using master-slave manipulators and/or other remote handling. Most vacuum systems will be needed for collection of dry materials; wet systems will also be needed on a less frequent basis. Collection canisters should be designed for direct disposal within, or integral with, standard waste burial containers.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification For Need:

Technical: All decontamination work will generate radioactive waste materials that will require a collection. Vacuum collection is favored over simple mechanical systems in order to minimize dispersing radionuclide material during collection and transfer. The final waste form will likely be transferred to a drying unit prior to packaging the dry solids. A vacuum transfer of the dry solids to the final waste disposal package is desired. High activity dispersible material will likely be placed in 10-inch diameter pipe containers

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Stakeholders are concerned about potential releases to the environment. The 324 and 327 Buildings are located within 1,000 ft of the Columbia River.

Other: None identified.

Current Baseline Technology: Mechanical scraping, scooping, clamshell, sweeping and some limited vacuum systems.

End-User: EM-40

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William

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Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, Gregory_T_Berlin@rl.gov.

DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: (509) 372-3508, David_T_Evans@rl.gov.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED CRANE TECHNOLOGY FOR BUILDING 324

Identification No.: RL-DD079

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford

PBS No: RL-RC06

Operable Unit (if applicable): N/A.

Waste Stream: N/A.

Waste Management Unit (if applicable): N/A.

Facility: Building 324

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

☐
☒
☐ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|---|

Need Title: Improved Crane Technology for Building 324

Need/Opportunity Category: *Technical Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Technologies, techniques, and methods are needed to provide upgrades to improve the reliability and maintainability of the 324 Building cranes. Upgrades would decrease downtime and would help to accelerate the deactivation schedule.

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/30/06)

Problem Description: Down-time from the presently deployed crane systems is a major factor in the risk to achieving TPA (regulatory) milestones under the 324 Building Closure Plan. Greater than \$1M per year is presently spent on crane repair and maintenance tasks.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A ROM LSCCS that could be realized from a 50% improvement in operational “up-time” between now and 2006 is a value in excess of \$3M.

Benefit to the Project Baseline of Filling Need: Improved crane reliability will reduce cleanup downtime and should result in schedule acceleration. Equipment maintenance staff would also incur less radiation dose.

Relevant PBS Milestone:

TRP-06-921 324 Deactivation Complete

September 22, 2006

Functional Performance Requirements: It is desired to upgrade existing cranes throughout the 324 Building to enhance both their reliability in a remote environment (especially the high-rad hot cells) and ease-of-repair. The hot cell environment contains high levels of radiation (2,000 to 5,000 R/hr) and chemical contamination.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: Crane reliability improvements are needed to support hot cell cleanout.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005.

Environmental Safety and Health: Improved crane reliability and maintainability will reduce the personnel exposure required to repair the current cranes.

Cultural/Stakeholder Concerns: Stakeholders are concerned about releases to the environment. The 324 Building is located within 1,000 ft of the Columbia River.

Other: Improved crane systems can be transferred to other facilities and applications.

Current Baseline Technology: 324 Building currently uses bridge cranes for a variety of lifting purposes.

End User: EM-40.

Contractor Facility/Project Manager: Malcolm S. Wright, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov)

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED SOLID WASTE PACKAGING FOR BUILDING 324

Identification No.: RL-DD080

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: LLW, TRU, Mixed

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: 324 Building

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved Solid Waste Packaging for Building 324

Need/Opportunity Category: *Technical Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Significantly lower-cost but functionally adequate waste containers are needed for Building 324.

Schedule Requirements:

Earliest Date Required: (01/01/01)

Latest Date Required: (09/30/06)

Problem Description: 324 Building deactivation costs are high, and a considerable cost is expended for the LLW/TRU and mixed waste disposal containers. In FY 2000, 14 mixed waste and over 20 LLW/TRU containers were packaged with waste. Over the next several years, a comparable number of containers are expected to be packaged and shipped. If less costly but functionally adequate waste containers can be identified and procured, significant programmatic savings may be realized.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD – Cost saving value may be estimated once alternative packaging is identified and assessed.

Benefit to the Project Baseline of Filling Need: Life cycle waste packaging and disposal cost would decrease.

Relevant PBS Milestone:

TRP-06-921 324 Deactivation Complete September 22, 2006

Functional Performance Requirements: It is desired to develop functionally adequate but lower cost alternatives to the Steel Waste Disposal Box (SWDB) system (over \$50K each) used for Mixed Waste disposal.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: None.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005.

Environmental Safety and Health: N/A

Cultural/Stakeholder Concerns: Stakeholders are concerned about releases to the environment. The 324 Building is located within 1,000 ft of the Columbia River.

Other: This may present an opportunity for minimizing operational expenses and life-cycle waste handling/disposal costs.

Current Baseline Technology: 324 Building currently uses 3-82B Grout Containers for LLW/TRU waste and Steel Waste Disposal Boxes (SWDBs) for mixed waste.

End User: EM-40.

Contractor Facility/Project Manager: Malcolm S. Wright, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov).

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DECONTAMINATION OF WET STORAGE BASIN IN BUILDING 327

Identification No.: RL-DD081

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No: RL-RC06

Waste Stream: Material with alpha, beta, and gamma contamination that is dispersible and likely embedded

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A.

Facility: Building 327

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Decontamination of Wet Storage Basin in Building 327

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline technology.

Need Description: A method to remove radioactive contaminants that have migrated into the surface of the concrete of the 327 (sample) storage basins. The contamination exists as a "bathtub ring" and as deposits of throughout the sides and bottom of the concrete basins. The contamination is the result of storing irradiated fuel samples prior to, during and after destructive examination and storage of breached Cesium capsules. The primary contaminants are mixed fission products with potential for transuranics. The basin has been coated (most likely with epoxy). The basin cannot be emptied of water until the contamination is either removed or additional shielding is provided. The water also acts as a contaminant containment barrier. No high-efficiency particulate air (HEPA) filtration system exists at either basin.

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/30/03)

Problem Description: Contamination represents an immediate worker exposure concern as well as a long-term environmental concern. The specific need is for the decontamination of highly contaminated (wet) storage basins in the 327 Facility. The Large Basin (3.1m x 4.6m x 5.2m) and Small Basin (1.8m x 2.4m x 3.1m) are connected by a 0.5m wide, 3.1m deep canal. The basins are coated concrete. In addition to the decontamination of the basins, disposal of a large legacy ion exchange column must be accomplished.

The storage basins are contaminated with cesium, strontium, uranium, and transuranic components. There is a concentration of contaminants in a “bathtub ring” located near the surface of the water. In addition to the “bathtub ring,” radioactive contamination has penetrated to varying depths into the concrete wall and floor surfaces.

Current decontamination practices include physical removal of the concrete surface (i.e., scabbling, sand blasting, etc.). None of these have been demonstrated underwater. Some contaminated concrete surfaces have also been painted and/or coated with a fixative. Project requirements may include removal of such coatings prior to decontamination of the concrete.

Waste minimization and remote handling methods are of prime importance.

Potential Life Cycle Cost Savings of Needs (in \$000s) and Costs Savings Explanation: TBD

Benefit to the Project Baseline of Filling Need: Remediation of basin contamination would represent a significant source-term reduction in the facility and ALARA improvement.

Relevant PBS Milestone:

TPR-07-930	327 Deactivation Complete	September 7, 2007
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Functional Performance Requirements: A decontamination method is needed that minimizes worker exposure, secondary waste generation, cost, and risk. A method that cleans to a level supporting end point criteria is required (that is, remove contamination within the basins and canal to support facility transition end-state requirements. The high contamination areas may be cleaned to a level (i.e. less than 100kdpm) that allows use of fixatives. The method should be readily deployable and capable of being remotely operated.

If underwater stripping technology is not employed, some form of airborne contaminant containment is necessary. The decontamination technology must be capable of operation on both vertical and horizontal surfaces. Removal of a fixative may also be required in most areas. The ability to collect and characterize contaminants as they are removed is also required.

Work Breakdown Structure: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: As facilities are transitioned to stable conditions and decommissioned, they require decontamination of radioactively contaminated materials. Current decontamination methods are often slow, costly, and produce secondary waste.

Regulatory: N/A

Environmental Safety and Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: The 327 Facility is located in close proximity to the Columbia River and the City of Richland; risk to the worker, public and environment should be minimized.

Other: None identified.

Current Baseline Technology: Hydro-lancing, ice/sand blasting, and scabbling

End User: EM-40.

Contractor Facility/Project Manager: William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

HIGH ACTIVITY HEPA FILTER CHANGEOUT AT 324 BUILDING

Identification No.: RL-DD087

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated HEPA filters

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: 324 Building

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: High Activity HEPA Filter Changeout at 324 Building

Need/Opportunity Category: *Technical Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description:

A remote method is needed to remove the high-dose, radioactive HEPA filter assembly from the exhaust system in the 324 Building. The filter assembly is approximately 4-ft (L) x 4-ft (W) by 7-ft (H) and weighs approximately 250 pounds.

Disposition of an A-Frame HEPA, located down steam from B-cell, presents several technical challenges due to limitations on existing cranes, high Curie loading, and size. Remotely deployable equipment will be necessary to minimize personnel exposure. The existing 30-ton overhead crane is unable to be positioned over the center of the concrete cover blocks; a specialized lift-centering device or hoisting system will be necessary. Special shielding and possibly remote/robotics will be needed for waste handling and stabilization, and the oversized nature of the filters will require a non-standard shielded container.

Schedule Requirements:

Earliest Date Required: (10/01/02)

Latest Date Required: (09/30/05)

Problem Description: The A-frame HEPA filter assembly is located in a filter pit covered by a 3-ton cover block. The filter assembly is designed to be contact-changed by craft personnel. Due to the high

dose, however, a remote/manual removal and packaging device is required. Access to the center of gravity of the cover block and filter assembly by the available overhead crane has been compromised.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Potential Cost savings are TBD at this time. Cost analyses can be performed once technology baseline and options are better established.

Benefit to the Project Baseline of Filling Need: Satisfaction of need will support ability to reach deactivation end states and provide readiness for D&D.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
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Functional Performance Requirements: The system must remove the cover block and withdraw the filter assembly into a shielded box. The shielded box must then be put into waste box for burial. Voids within the box must be filled with grout.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification For Need:

Technical: As facilities are transitioned to stable conditions and decommissioned, they require decontamination of radioactively contaminated materials.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005.

Environmental Safety and Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Decontaminating materials to free release can minimize the volume of material destined for onsite burial. This will help alleviate concerns expressed by stakeholder groups.

Other: None identified.

Current Baseline Technology: None -- situation represents unique challenges.

End-User: EM-40

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov)

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DOE End-User/Representative Point-of-Contact: David T. Evans, U.S. Department of Energy, Richland Operations Office (DOE-RL), (509) 373-9278, Fax: (509) 372-3508, [David T Evans@rl.gov](mailto:David_T_Evans@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

**REMOTE ACCESS TECHNOLOGIES FOR WASTE RETRIEVAL
IN BUILDINGS 324 AND 327**

Identification No.: RL-DD088

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford

PBS No.: RL-RC06

Waste Stream: Exotic metals from research reactor materials testing

TSD Title: N/A

Operable Unit (if applicable): N/A.

Waste Management Unit (if applicable): N/A.

Facility: Buildings 324 and 327

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote access technologies for waste retrieval in Buildings 324 and 327

Need/Opportunity Category: *Technology Opportunity* -- The Site desires alternatives to the current or planned baseline technology/process (e.g., a baseline technology exists but can be improved).

Need Description: A variety of tools and techniques are needed for gaining access to “difficult to reach” spaces within high-radiation rooms, cells, tunnels and various waste site locations within the 324 and 327 Building. These access tools are primarily needed to help deploy visual characterization tools, support waste item / debris retrieval and possibly decontamination. This need statement is intended to cover remote access challenge that may not be directly addressed though RL-DD010 “Radiation Hardened Robotics for Building 324” and RL-DD079 “Improved Crane Technology for Building 324”.

Schedule Requirements:

Earliest Date Required: (01/2002)

Latest Date Required: (09/2007)

Problem Description: A number of radioactive metals specimen areas storage areas within the 324 and 327 Buildings are presently inaccessible with in-house equipment.

Hundreds to thousands of Materials Open Test Assembly (MOTA) specimens are currently stored in the 324 Building’s Shielded Materials Facility (SMF) South Cell (Room 140). The MOTA specimens are housed in two shielded storage caves located in the northeast and northwest corners of South Cell. Each cave is comprised of 13 drawers with up to 195 bins per drawer. Each cave has a shielded lid which, when lifted, also lifts and exposes the drawers. The MOTA specimens are typically a metallic vial (<1”)

composed of exotic metals from the Fast Flux Test Facility (FFTF) development and testing and from other worldwide programs. An overhead crane in the SMF South Cell would normally be utilized to gain access to the drawers by lifting the cave lid. However, the crane is inoperable, and the repairs cannot be accomplished due to the high source term currently in the cell. The weight of the cave lid greatly exceeds the payload capacity of the hot cell manipulators.

A wet basin once used for materials transfer between the 324 Building Cask Handling Area and the SMF hot cells was later abandoned by backfilling with sand and capping with concrete. A small portion of a transfer tunnel between SMF and the abandoned basin requires specialized equipment to access, inspect and retrieve any material/debris that may have been left from SMF operations.

Among others, another example of remote access challenges involves the 327 Building's Dry Storage Facility, which is comprised of an underground shielded area containing five stacked rotating tables equipped with storage cells. HEPA filtered exhaust is provided to the storage facility for contamination control. A special transfer cask was designed with a suction tool that is utilized to transfer samples into and retrieve them from the facility. Archive test samples have been accumulated in "soup" sized cans in this facility for the past 40 years. A concerted effort has been made in the past two years to remove these archived fuel and structural material samples. Samples are highly radioactive and some contain fissile material. To date, nearly 300 samples have been successfully removed. However, due to technical difficulties, several samples are not retrievable using standard transfer techniques. An additional sample has been identified on the floor of the facility under the bottom shelf. In addition, a video inspection has identified several storage positions with items that appear to be non-containerized samples that also cannot be removed by conventional methods. The only access to the Dry Storage Facility is through five 2" access ports at floor level. Technique and tooling needs to be developed to retrieve these samples in support of facility deactivation.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: In most cases, the new tools will be viewed as "enabling" technologies, and would not necessarily represent a cost saving unless comparing the alternative of doing nothing and therefore delaying deactivation progress.

Benefit to the Project Baseline of Filling Need: Benefits realized by the Projects should include characterization task efficiencies/schedule reduction, waste volume/class reduction and the reduction in associated disposal costs. Dose reduction and ALARA-based improvements should also be realized.

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: Remote systems must be able to perform remote activities requiring a range of motions and weight requirements in high-radiation fields (on the order of 2,000 to 5,000 R/hr). The associated tooling may be operated pneumatically, hydraulically, or electrically, but must be able to withstand the harsh environments of the hot cells.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

Justification for Need:

Technical: Adequate characterization will be used to perform the Final Hazards Analysis prior to completing deactivation end points.

Regulatory: Tri-Party Agreement Milestone M-89-00: Complete Closure of the Non-permitted MW Units of the 324 REC, HLV and LLV by October 2005. The 327 Building contains no TSD units; only the generating facility requirements of RCRA apply.

Environmental Safety and Health: Supports as low as reasonably achievable (ALARA) and radiological mapping for future decontamination and decommissioning (D&D) efforts.

Cultural/Stakeholder Concerns: Reduce employee exposure to toxic and/or radioactive materials. Better characterization data will lead to better and more cost-effective decontamination/removal decisions, thus minimizing quantities of materials handled, stored, or disposed of as a waste product.

Other: None identified.

Current Baseline Technology: In some cases, a baseline technology does not exist, and with therefore be viewed as “enabling”. Other baseline methods involve the use of specialty tools designed to be deployed from an overhead crane (if operating) or hot cell manipulator arms.

End-User: EM-60.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

Site Technical Point-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509) 376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov).

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DEACTIVATION

BUILDINGS 310/TEDF AND 340 VAULT

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

RETRIEVAL OF WASTE HEEL FROM VAULT TANKS AT 340 FACILITY

Identification No.: RL-DD082

Date: November 2001

Program: River Corridor Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS Number: RL-RC05

Waste Stream: TRU-MW Liquid and Sludge Heel in 340 Vault Tanks (to be eventually transferred to RL-HLW-20 tank waste)

TSD Title: N/A

Operable Unit (if applicable): N/A (near 300-FF-2)

Waste Management Unit (if applicable): N/A

Facility: 340 Vault Facility, Hanford's 300 Area

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Retrieval of Waste Heel from Vault Tanks at 340 Facility

Need/Opportunity Category: *Technology Opportunity* -- The Site desires an alternative to the current baseline approach and schedule.

Need Description: A method is needed for removing residual waste from two 15,000 gallon tanks. The tanks are situated below grade in a concrete vault. Waste remaining in each tank is comprised of about 1,100 gallons of liquids, sludge, solids and dispersible materials. A similar need is documented in Technology Need RL-DD09.

Schedule Requirements:

Earliest Date Required: (01/01/02)

Latest Date Required: (09/30/06)

These tanks are part of a Tri-Party Agreement milestone (M-92-13/16) related to "Special Case Waste" disposition in the 300 Area. These milestones involve a large set of 300 Area waste streams which must be fully dispositioned before FY 2006 – about one-third of the entire set must be addressed by 2002, and other third by 2004, and finally all waste dispositioned by the end of FY 2006.

Problem Description: Tank internals that may challenge the cleanout effort include a four-paddle, 42-inch diameter, agitator located near the bottom of the tank but above the tank heel level. The tanks also have three, concentrically spaced, vertical support baffles in the interior knuckle region of the tank (likely regions of sludge "hold-up")

As part of the initial 340 Facility deactivation activities in 1998, the tanks were pumped to remove all but the last/lowest 20 inches of liquids and sludge. This 20-inch waste level represents the lowest elevation of the in-tank pump inlet.

Until 1998, the 340 Facility received liquids wastes from a variety of sources in Hanford's 300 Area, and then transferred the liquids to a railroad tanker for transport to the 200 Area Tank Farms. In 1998, the Hanford railroad network was shut down as was the 340 waste receiving and transfer operations.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Removal of the waste heel may allow for a down-classification from a Non-Reactor Nuclear Facility (Hazard Class III) to Radiological Facility status. This effort would support the ability to downgrade the facility from a "Major Stack" classification for air permitting concerns. This change could also allow for reduction of the 340 Facility FSAR or Interim Safety Basis requirements. The removal of the liquid/sludge heels will result in a mortgage reduction for the life of the facility. The estimated cost to remove the heels will be recovered by FY 2003, resulting in an estimated savings of \$2.8M by FY 2006 (based on the associated TPA Milestone date).

Benefit to the Project Baseline of Filling Need: Safety/environmental hazard located near the Columbia River.

Relevant PBS Milestone: TBD

Functional Performance Requirements: The selected technology should be capable of flushing all portions/sides of the internal structures. The technology may need to utilize flexible piping, as direct access to vertical tank risers may not be practical. The possibility also exists for installing new tank risers and/or core drilling cover blocks if necessary/optimum for equipment location. Also, relocating attachment points for the current fall protection cables could free up access hatches for such use. The selected technology should minimize the introduction of additional liquids. The waste heel does include TRU nuclides, and may be present in concentrations that would classify the waste as TRU.

Work Breakdown Structure (WBS) No.: 1.2.3.2.3 – 340 Deactivation

TIP No.: N/A

Justification for Need:

Technical: Elimination of the residual heels and reduction of the radiological field is necessary before the tanks can be size reduced and/or removed for disposal.

Regulatory: See reference to Tri-Party Agreement milestone (M-92-13/16) noted above. State and Federal regulators have established a compliance order for dealing with a number of "Special Case Waste" streams in the 300 Area. The heel remaining in the 340 tanks is included in this TPA milestone.

Environmental Safety and Health: The proximity of the tanks to the Columbia River and the City of Richland strengthens the need to accelerate heel removal.

Cultural/Stakeholder Concerns: The 340 High Level Vault Tanks are located within 500 yards of the Columbia River, and just north of the City of Richland property limits.

Other: None identified.

Current Baseline Technology: The 340 Facility Project Management Plan (PMP) baseline assumes use of a robotic crawler/suction system for the purpose of heel-removal cost estimates. Such an approach has since been demonstrated elsewhere at Hanford with shortcomings.

End User: EM-30

Contractor Facility/Project Manager: Donald J. McBride, Fluor Hanford (FH) (509) 373-5698, Fax (509) 376-6423, [Donald J Don McBride@rl.gov](mailto:Donald_J_Don_McBride@rl.gov)

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IN-LINE RADIATION DETECTION AT VERY LOW LEVELS IN WASTEWATER

Identification No.: RL-DD083

Date: November 2001

Program: River Corridor Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC05

Waste Stream: 300 Area Process Sewer

TSD Title: 300 Area Treated Effluent Disposal Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: 300 Area Treated Effluent Disposal Facility, Hanford's 300 Area

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: In-line Radioactivity Detection at Very Low Levels in Wastewater

Need/Opportunity Category: *Technology Opportunity* -- The Site desires capability to perform on-line monitoring of a wastewater stream for radioactivity at very low levels.

Need Description: The 300 Area Treated Effluent Disposal Facility (TEDF) is a non-nuclear facility that treats industrial wastewater and discharges it to the Columbia River under an NPDES permit. The bulk of the water treated at the TEDF is collected and transported through the 300 Area Process Sewer. The Process Sewer has connections to approximately 45 buildings in the 300 Area. Even though physical and administrative controls exist to preclude entry of radioactive material in to the Process Sewer system, upsets have occurred and have the potential to occur in the future. The TEDF does not include any treatment for radioactive constituents and must meet drinking water standards in the effluent. See standards noted in *Functional Performance Requirements*.

A monitoring system is needed to mitigate the impacts of radiological upsets in the Process Sewer and ensure compliance with discharge limits.

Schedule Requirements:

Earliest Date Required: N/A

Latest Date Required: N/A

There are no particular schedule drivers.

Problem Description: See "Need Description" entry above.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The only cost savings would be avoidance costs associated with a potential discharge criteria violation and associated clean up. This cannot adequately be qualified.

Benefit to the Project Baseline of Filling Need: Minimization of safety/environmental hazard potential located near the Columbia River.

Relevant PBS Milestone: N/A

Functional Performance Requirements: The selected technology should be capable of on-line real time monitoring of alpha and beta activity. The waste stream is industrial wastewater mostly from HVAC and equipment cooling water. The detector must be capable of detecting down to drinking water standards (15pCi/l alpha, 50pCi/l beta) with a high degree of operational reliability and little operator involvement.

Work Breakdown Structure (WBS) No.: 1.2.3.2.1, Maintain 300 Area LEF (TEFD) Readiness

TIP No.: N/A

Justification for Need:

Technical: Commercially available, on-line process detectors that are capable of sensing at state drinking water standard levels (e.g., 15pCi/l alpha, 50pCi/l beta) are not known to be available.

Regulatory: Availability of a monitoring system will significantly reduce the risk of the TEDF discharging wastewater in excess of the discharge criteria.

Environmental Safety and Health: Additional protection for the Columbia River.

Cultural/Stakeholder Concerns: None identified.

Other: None identified.

Current Baseline Technology: Currently no monitoring is being conducted on the combined Process Sewer stream. Composite samples are taken and analyzed in a lab monthly or after an upset.

End User: EM-30

Contractor Facility/Project Manager: Donald J. McBride, Fluor Hanford (FH) (509) 373-5698, Fax (509) 376-6423, Donald_J_Don_McBride@rl.gov

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DEACTIVATION

SPENT NUCLEAR FUEL PROJECT

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTAMINANT MAPPING OF K BASINS

Identification No.: RL-SNF01

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: ERW-02 MLLW Debris to ERDF (Radioactively contaminated surfaces with loose or dispersible contamination).

TSD Title: N/A

Operable Unit (if applicable): 100-KR-2

Waste Management Unit (if applicable): N/A

Facility: K Basins

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Contaminant Mapping of K Basins.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: A method to map the location and activity levels of radioactive contaminants on underwater vertical and horizontal surfaces is needed.

Schedule Requirements:

Earliest Date Required: (10/2001)

Latest Date Required: (06/2002)

The removal of fuel from the K Basins is scheduled for completion in 2004. Mapping of wall and floor contaminants is needed to support development of deactivation plans. Deactivation plans must be in place prior to initiation of decontamination activities. Completion of the K Basin Deactivation program is currently scheduled for July 2007.

Problem Description: Residual surface contamination is present on KE Basin surfaces and may also be present on KW Basin surfaces (basin walls and floors) and in the area surrounding the K Basin fuel storage pools. Residual contamination presents a worker exposure concern. The location and activity level of contaminants needs to be identified to enable proper selection of a decontamination technology. Identification of the decontamination technology is necessary before project baselines can be developed.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Potential life cycle savings for contaminant mapping of the K basins is estimated to be \$400,000. This estimate is based on current project total cost for decontamination of the both KE and KW Basins.

Benefit to the Project Baseline of Filling Need: Identification of a remote mapping method in a submerged location will speed up deactivation activity with the K Basin pools. It will also result in a cost-effective approach for decontamination.

Relevant PBS Milestone: S00-01-909 - Complete Spent Nuclear Fuel Project

Functional Performance Requirements: The mapping technology must be able to locate and identify the activity level of alpha, beta, and gamma contamination on both vertical and horizontal surfaces. The mapping must be performed remotely and underwater. The surfaces are not uniform with sections that vary in width from 1 in. to 125 ft.

Work Breakdown Structure (WBS) No.: 1.3.1

TIP No.: S10-99-950

Justification For Need:

Technical: The location and activity level of contaminants needs to be identified to enable proper selection of a cost-effective decontamination technology. Identification of the decontamination technology is necessary before project baselines can be developed. Residual radioactive contamination presents safety and exposure concerns.

Regulatory: Tri-Party Agreement milestone M-34-00A requires complete removal of spent nuclear fuel, sludge, debris, and water by July 31, 2007.

Environmental Safety & Health: Residual radioactive contamination presents safety and exposure concerns.

Cultural/Stakeholder Concerns: Employee and public exposure to radioactive materials is a concern of Hanford Site stakeholders.

Other: None identified.

Current Baseline Technology: N/A.

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DECONTAMINATION OF K BASIN POOL

Identification No.: RL-SNF02

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: ERW-02 MLLW Debris to ERDF (Beta and Gamma contamination that is embedded in concrete).

TSD Title: N/A

Operable Unit (if applicable): 100-KR-2

Waste Management Unit (if applicable): N/A

Facility: KE Basin

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Decontamination of K Basin Pool.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: A method to remove radioactive contaminants that have migrated into the surface of the concrete of the KE Basin fuel storage pool. The contamination exists as a "bathtub ring" and as deposits of varying thicknesses throughout the sides and bottom of the concrete pool. The primary contaminants are cesium and strontium. The upper level of the basin wall has been treated with epoxy and the water level has been raised to provide shielding during fuel and sludge removal. The basin cannot be emptied of water until the contamination is either removed or additional shielding is provided. The water also acts as a contaminant containment barrier. No high-efficiency particulate air (HEPA) filtration system exists at either basin.

Schedule Requirements:

Earliest Date Required: (09/2002)

Latest Date Required: (09/2003)

The removal of fuel from the K Basins is scheduled for completion in 2004. Decontamination of the pool will proceed shortly thereafter. Completion of the K Basin Deactivation program is currently scheduled for July 2007.

Problem Description: Contamination represents an immediate worker exposure concern as well as a long-term environmental concern. The KE Basin pool is contaminated with cesium, strontium, uranium, and transuranic components. The presence of these contaminants prevents drainage of the basin as the water serves as a radiation shield and containment barrier. There is a concentration of contaminants in a “bathtub ring” located near the surface of the water.

In addition to the “bathtub ring,” radioactive contamination has penetrated to varying depths into the concrete wall and floor surfaces. Current decontamination practices include physical removal of the concrete surface (i.e., scabbling, sand blasting, etc.). None of these have been demonstrated underwater. Some contaminated concrete surfaces have also been painted and/or coated with a fixative. Project requirements may include removal of such coatings prior to decontamination of the concrete.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Mortgage rates can be reduced through the implementation of cost-effective methods for decontamination and the transition of the facility into a stable condition that requires low surveillance and maintenance. New technology has the potential of reducing the cost by approximately 20% of the cost of the baseline technology. Baseline technology ROM is \$17 M, therefore, ROM cost savings is \$3.4 M.

Benefit to the Project Baseline of Filling Need: Identification of an appropriate method for decontaminating the KE Basin pool will allow completion of basin deactivation activities, thereby supporting the Hanford Site cleanup progress.

Relevant PBS Milestone: S00-01-909 - Complete Spent Nuclear Fuel Project

Functional Performance Requirements: A decontamination method is needed that minimizes worker exposure, secondary waste generation, cost, and risk. It also should be readily deployable. Concrete decontamination technologies shall be capable of being remotely operated and mobile supplemental shielding must be provided to minimize worker exposure during setup.

Underwater stripping technologies must minimize turbidity (maintaining water clarity is a major concern). If underwater stripping technology is not employed, some form of airborne contaminant containment is necessary. The decontamination technology must be capable of operation on both vertical and horizontal surfaces. These surfaces are not uniform with sections that vary in width from 1 inch to 125 feet. Removal of a fixative may also be required in some areas. The ability to collect and characterize contaminants as they are removed is also required.

Work Breakdown Structure (WBS) No.: 1.3.1

TIP No.: S10-99-950

Justification For Need:

Technical: Decommissioning of the K Basin pool to a stable condition requires the removal of the pool water. This cannot occur until the level of residual contamination can be reduced or shielded to a safe level because the water in the pool currently serves as a radiation shield. Any remaining residual contaminants must be fixed in place after water removal because the basin does not have a HEPA filtration system.

Regulatory: Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) milestone M-34-00A requires complete removal of spent nuclear fuel, sludge, debris, and water by July 31, 2007. Radiation levels must be reduced prior to removal of shielding water.

Environmental Safety & Health: Radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Decontamination of materials and equipment that are present in facilities near the Columbia River reduces the risk of offsite contamination.

Other: None identified.

Current Baseline Technology: N/A.

End-User: SNF Project, Larry McDaniel (509) 373-0199

Contractor Facility/Project Manager: SNF Process Engineering, Jim McClusky, Fluor Hanford (FH), (509) 373-2281, Fax (509) 373-1542, [James K McClusky@rl.gov](mailto:James_K_McClusky@rl.gov)

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIXATIVES FOR K BASIN

Identification No.: RL-SNF03

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: N/A (Radioactively contaminated surfaces with loose or dispersible contamination).

TSD Title: N/A

Operable Unit (if applicable): 100-KR-2

Waste Management Unit (if applicable): N/A

Facility: K Basins

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

☐
☒
☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|--|

Need Title: Fixatives for K Basin.

Need/Opportunity Category: *Technology Opportunity* -- The site desires an alternative to the current or planned baseline technology / process (e.g., a baseline exists but can be improved).

Need Description: Long-life fixatives to contain dispersible radioactive materials that are easily applied to and removed from surfaces are needed.

Schedule Requirements:

Earliest Date Required: (09/2002)

Latest Date Required: (09/2003)

The removal of fuel from the K Basins is scheduled for completion in 2004. Decontamination of the pool will proceed shortly thereafter. Completion of the K Basin Deactivation program is currently scheduled for July 2007.

Problem Description: Dispersible surface contamination may be present on KW Basin surfaces, will be present on KE Basin surfaces (basin walls and floors), and may also be present in the area surrounding the K Basin fuel storage pools. Such dispersible contamination presents a worker exposure concern and constitutes a long-term environmental concern because neither basin has HEPA filtration. In areas where decontamination is not feasible, dispersible contamination is fixed in place.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Potential life cycle savings for fixatives for the KE are estimated to be \$300, 000. The estimate is based on best engineering judgment of mortgage reduction costs associated with having contamination fixed to the basin surfaces.

Benefit to the Project Baseline of Filling Need: Eliminate use of current technology thus reducing the high maintenance cost.

Relevant PBS Milestone: S00-01-909 - Complete Spent Nuclear Fuel Project

Functional Performance Requirements: The fixative must be able to immobilize dispersible alpha, beta, and gamma contamination. The fixative must be easily removable to allow for eventual decontamination. It needs to last 20 to 25 years, and a thin film is preferred. At KE Basin, the fixative will need to be applied remotely, either in air or underwater. The fixative method must accommodate coating of both vertical and horizontal surfaces. The surfaces are not uniform with sections that vary in width from 1 inch to 125 feet.

Work Breakdown Structure (WBS) No.: 1.3.1

TIP No.: S10-99-950

Justification For Need:

Technical: Dispersible radioactive contamination presents safety/exposure concerns.

Regulatory: Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) milestone M-34-00A requires complete removal of spent nuclear fuel, sludge, debris, and water by July 31, 2007. Shielding water cannot be removed until radiation and contamination are reduced.

Environmental Safety & Health: Dispersible radioactive contamination presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Employee and public exposure to radioactive materials is a concern of Hanford stakeholders.

Other: None identified.

Current Baseline Technology: Tar, paint, polymers.

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**DECOMMISSIONING
(Environmental Restoration Project)**

FY 2002 TECHNOLOGY NEEDS STATEMENTS

Surveillance/Maintenance and Transition Project

Canyon Disposition Initiative (CDI)

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE/ROBOTIC TECHNOLOGIES FOR CDI

Identification No.: RL-DD034

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: Remote Operations for LLW Debris (ER-05, risk = 4), MLLW Debris (ER-02, risk = 4) and TRU Debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit: N/A

Facility: Materials processing facilities (five processing canyons)

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
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Need Title: Remote/robotic technologies for access and deployment of tools and equipment for size reduction, waste emplacement, void space filling, and some dismantling.

Need/Opportunity Category: *Technology need* - there is no existing or currently identified technology for some portions of the facility.

Need Description: Remote technology is needed for access and deployment of equipment and tools throughout the 221-U Facility. Some areas cannot be reached using conventional methods or personnel. Remote systems are needed for entry, size reduction, dismantlement, void space filling, and waste emplacement. Size reduction and void space filling will be needed during facility operations if the facility is used for waste emplacement. Remote capabilities may also be required for void filling and waste emplacement exterior to the facility. However, it is assumed standard burial practices will be used.

Schedule Requirements:

Earliest Date Required: 3/31/2002 for waste encapsulation

Latest Date Required: Unknown for waste encapsulation

Problem Description: Robotic platforms are required for waste emplacement, void filling, dismantling and size reduction in areas of the 221-U Facility where manned entry is not possible.

The canyon deck is covered with extraneous equipment received from other facilities. The transport of equipment of any size through the canyon facility is very difficult if it has to be done on the canyon deck. The cells are congested with piping and vessels, and the hot pipe trench is very congested with small diameter piping. Waste emplacement and void filling may be performed under current facility conditions.

Benefit to the Project Baseline of Filling Need: Personnel exposure should be reduced, and time and cost should be reduced.

Functional Performance Requirements: The remote technologies must function in a highly radioactive environment (up to 500 R/hr, more typically up to 10 R/hr), process chemicals, acids, and caustic solutions. Deployments are required in highly congested areas such as the cells. See the general information section for additional description of the 221-U Facility.

Any crane deployable manipulator system must be integrated with characterization, sampling, and other tools defined as needed in order to support the record of decision (ROD) process and beyond (e.g., waste emplacement, volume reduction, and void filling). The system must have a significant payload capacity (>200 pounds), be easily maintainable, have readily replaceable parts, be operable by facility personnel, and have the ability to accept new tools (end-effectors) as new needs are identified in the facility. It must be deployable on one of the 10-ton auxiliary hoists, and work in concert with the 75-ton crane. Controls for the system must be operable from the confined space crane cab or from the operating gallery.

WBS No.: 1.4.03.3.1.04.05.03.01.41.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Waste emplacement, void filling, and size reduction would be needed if the facility were used for waste emplacement. Dismantling capabilities may be needed for both the characterization and operational phases.

Regulatory: Final disposition of the 221-U Facility will be determined by a quantitative and qualitative analysis based on the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

Environmental Safety & Health: Remote capabilities will result in reduced worker exposure, reduced contamination spread and the ability to perform functions in areas that cannot be reached with the current baseline technologies.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of up to \$70M (based on the potential costs and savings identified in DOE/RL-2001-29 Draft A). A Record of Decision (ROD) will determine the disposition of the 221-U Facility. A decision to reuse all Hanford materials processing facilities as a waste disposal site could result in a potential cost savings of approximately \$70M. Meeting this technology need will support obtaining a ROD.

Cultural/Stakeholder Concerns: Improved protection of the environment and of public health and safety.

Other: There are five main processing facilities on the Hanford Site, two at Idaho, and one at Savannah River. Technologies that meet needs at the 221-U Facility will be applicable at these and other similar DOE facilities.

Current Baseline Technology: The 221-U Facility canyon deck is a respirator area, so personnel access is allowed. Manned operations would be considered the baseline technology. The process cells, ventilation tunnel, and hot pipe trench are prohibitive for personnel access. In those portions of the facility there is no current baseline technology.

End User: Waste Management Project, Environmental Restoration Project, Facility Stabilization Project

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

VOLUME REDUCTION OF EQUIPMENT FOR CDI

Identification No.: RL-DD048

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW Debris (ER-05, risk = 4), MLLW Debris (ER-02, risk = 4) and TRU Debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit: N/A

Facility: Materials processing facilities (five processing canyons)

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Volume reduction of equipment in the 221-U Facility for the Canyon Disposition Initiative (CDI) Project.

Need/Opportunity Category: *Technology opportunity* - the user is interested in the opportunity to improve on the currently identified or planned baseline technology.

Need Description: The equipment on the canyon deck and in the process cells of the 221-U Facility consists of large carbon steel and stainless steel equipment used in processing spent nuclear fuel. Most of the equipment on the canyon deck came from fuel processing facilities and is similar to the equipment found in the 221-U process cells. The equipment includes tanks, pulsers, agitators, centrifuges, concentrators and dissolvers. The equipment has internal void spaces, which are not allowed in shallow burial grounds (ERDF and Hanford Central Waste Waste Acceptance Criteria), and non-uniform shapes that do not allow for optimal facility waste loading. The preferred treatment method, volume reduction through direct compaction, will minimize internal void spaces and will create optimal shapes for final disposal, either inside the facility or at a shallow burial ground.

Schedule Requirements:

Earliest Date Required: Volume reduction technology may be needed for operations as early as March 2003.

Latest Date Required: Unknown

Problem Description: The waste acceptance criteria for shallow burial require the filling of void spaces (i.e., not having void spaces). Large equipment, as that in the 221-U Facility, has internal void spaces and non-uniform shapes that cause void spaces when packaged. The equipment could be dismantled and packaged without volume reduction, but would require void filler and cost more to handle and dispose of.

Volume reducing the equipment, with or without dismantlement, would minimize the internal void spaces and create more uniform “packages” for handling. This need relates to functions number 1.0 and 2.0 of the CDI Feasibility Study.

Benefit to the Project Baseline of Filling Need: If this need is filled, volume reduction will be accomplished with little to no exposure to personnel while still allowing for optimal use of the facility as a waste disposal site. Such a technique would also save time and personnel cost in comparison to segmenting equipment and components.

Functional Performance Requirements: The volume reduction technology must operate within the 221-U Facility using standard power. It is preferred that the technology be able to volume reduce equipment in situ (without dismantlement). Technology is needed for both in cell and freestanding equipment as large as 13’ X 18’ X 20’ high. Any volume reduction technology must operate without compromising the structural integrity or seismic loading of the building. Note that separate technologies may be acceptable for freestanding and in-cell equipment volume reduction.

WBS No: 1.4.03.3.1.04.05.03.01.41.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: In situ volume reduction will result in optimal handling and disposal of the equipment in the 221-U Facility.

Regulatory: Unknown.

Environmental Safety and Health: In situ volume reduction of the equipment within the 221-U Facility would result in less waste handling (e.g., cutting up of equipment to fit into waste packages), and therefore, much less potential exposure to the workers.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$55K. LCC savings estimate is based on the assumption that volume reduction equipment would reduce the total operations and management (O&M) costs of the close in place – collapsed structure alternative by 1%. The close in place – collapsed structure (alternative 6) (O&M) costs are estimated as \$1.1M in DOE/RL-2001-29 Draft A. Less handling of radioactive waste material will result in direct cost savings from reduced labor. In situ volume reduction will also result in further cost savings by reducing the quantity of waste to be disposed.

Cultural/Stakeholder Concerns: Improved protection of the environment and of public health and safety.

Other: There are five main processing facilities on the Hanford Site, two at Idaho, and one at Savannah River. Technologies that meet the needs at the 221-U Facility will be applicable at these and other similar DOE facilities.

Current Baseline Technology: Baselines exist for “no volume reduction” and “volume reduction of packaged material.” For the no volume reduction baseline, equipment in 221-U would have internal void spaces filled with concrete or soil and then would be treated as waste packages. For the volume reduction

of packaged material baseline, equipment would be dismantled to fit into standard waste containers (e.g., 55-gallon drums) and then either compacted or the void spaces filled (usually with a clean filler). Compaction is the baseline technology used for volume reduction of packaged material.

End-User: Waste Management Project, Environmental Restoration Project, and Facility Stabilization Project

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

WASTE ENCAPSULATION AND STABILIZATION FOR CDI

Identification No.: RL-DD049

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW Debris (ER-05, risk = 4) and MLLW Debris (ER-02, risk = 4)

TSD Title: N/A

Waste Management Unit: N/A

Facility: Materials processing facilities (five processing canyons)

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
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Need Title: Encapsulation and stabilization of waste inside the 221-U Facility for the Canyon Disposition Initiative (CDI) Project. (This need statement does not address encapsulation of waste placed exterior to the facility as it is assumed standard burial procedures will apply.)

Need/Opportunity Category: *Technology opportunity* - the user is interested in the opportunity to improve on the currently identified or planned baseline technology.

Need Description: If the Canyon Disposal Initiative (CDI) record of decision is to use the 221-U Facility as a waste disposal site, then the site must meet waste disposal site requirements. Requirements include filling of void spaces in equipment and around waste packages to avoid subsidence. Stabilization of the facility structure is also required. Since the facility structure provides added protection from potential contamination leakage to the environment, it is necessary to assure the structure is maintained during and after waste disposal in the facility.

Schedule Requirements:

Earliest Date Required: Encapsulation and stabilization technology may be needed for operations as early as March 2003.

Latest Date Required: Unknown

Problem Description: There is a requirement for filling void spaces in shallow burial grounds. Using materials processing facilities for waste disposal will have the same requirements as a shallow burial site and will have to assure there is no damage to the structure, thus reducing the probability of a potential contamination release to the environment. This need relates to functions number 2.0 and 3.0 of the CDI Feasibility Study.

Benefit to the Project Baseline of Filling Need: Fulfilling this need will help enable the use of the canyon facilities as waste disposal facilities.

Functional Performance Requirements: The encapsulation and stabilization technology must fill void spaces between waste packages, and be useable on a large scale (within the open area of a materials processing facility). The technology must be useable in a layered manner. As waste packages are layered within the facility, the encapsulation/stabilization technology can be applied to provide a surface for the next layer of waste and provide a continuous filler as multiple layers are added (no breaks in the material used). It is also required that the technology not damage the facility structure. The process must meet RCRA treatment standards for encapsulation. The “technology” includes the application process, the material to be applied, and the means of assuring void spaces have been filled.

WBS No.: 1.4.03.3.1.04.05.03.01.41.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: It is required that void spaces be filled in burial grounds to avoid subsidence and that waste be stabilized to reduce the potential for a release to the environment. Also, due to the defined use of the facilities, it is required that the structural integrity of the facility be maintained.

Regulatory: RCRA treatment standards may apply to some waste disposed to the canyon. Encapsulation may be proposed as the single treatment standard.

Environmental Safety and Health: By assuring no subsidence, stabilization of the waste, and structural integrity, there will be minimal potential for a release to the environment.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$55K. LCC savings estimate is based on the assumption that a waste encapsulation technology would reduce the total operations and management (O&M) costs of the close in place – collapsed structure alternative by 1%. The close in place – collapsed structure (alternative 6) O&M costs are estimated as \$1.1M in DOE/RL-2001-29 Draft A.. A Record of Decision (ROD) will determine the disposition of the 221-U Facility.

Cultural/Stakeholder Concerns: Encapsulation will minimize spread of contamination.

Other: There are five main processing facilities on the Hanford Site, two at Idaho, and one at Savannah River. Technologies that meet the needs at the 221-U Facility will be applicable at these and other similar DOE facilities.

Current Baseline Technology: The planned baseline for encapsulation at the 221-U Facility is concrete or soil (CDI Feasibility Study). Typical waste package (i.e., individual packages) fillers include zeolite and dirt. Grout, bentonite, and diatomaceous earth have also been used for encapsulation and stabilization of individual packages.

End-User: Waste Management Project, Environmental Restoration Project, and Facility Stabilization Project

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

HIGH PROFILE SURFACE BARRIER FOR CDI

Identification No.: RL-DD051

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Containment of LLW Debris (ER-05, risk = 4) and MLLW Debris (ER-02, risk = 4)

TSD Title: N/A

Waste Management Unit: N/A

Facility: Materials processing facilities (five processing canyons)

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: High profile surface barrier for the Canyon Disposition Initiative (CDI) Project.

Need/Opportunity Category: *Technology need* - there is no existing or currently identified technology for the project baseline.

Need Description: A surface barrier design is needed that provides for steep side slopes (e.g., 1:3) yet still protects against water infiltration, wind and water erosion, and plant, animal, and inadvertent human intrusion.

Schedule Requirements:

Earliest Date Required: A high profile barrier may be needed for operations as early as year 2008.

Latest Date Required: Unknown.

Problem Description: Fifty years of defense plutonium production resulted in the construction of five large material processing facilities at the Hanford Site. An acceptable long-life surface barrier would help support decisions to cap these facilities in place. Currently, there are no proven designs that accommodate the large side slopes that would be necessary to cost-effectively cap such facilities. This need relates to functions number 2.0 and 3.0 of the CDI Feasibility Study.

Benefit to the Project Baseline of Filling Need: Fulfilling this need is critical in enabling the use of the canyon facilities as waste disposal facilities. Without sufficient barriers and sufficient information to support the use of them, the facilities cannot be used to the maximum extent for waste disposal (i.e., intact and used for disposal) and the potential savings will not be achieved.

Functional Performance Requirements: The barrier design should meet RCRA requirements. Quantitative requirements will be a function of the contaminants remaining or disposed in the facilities. At a minimum,

the barrier design should minimize wind and water erosion, limit water infiltration, and prevent plant, animal, and inadvertent human intrusion. The barrier should channel precipitation away from the waste site and require little or no maintenance. The barrier should be stable and retain its performance features for a minimum of 500 years. The barrier must meet these requirements for situations where the barrier is elevated as much as 60 ft above the surrounding terrain. This technology need relates to the generation and subsequent regulatory acceptance of adequate design, selection, validation, and monitoring results. Acceptance of these results will allow an environmentally sound, cost-effective, design for barrier implementation over decommissioned intact facilities.

WBS No.: 1.4.03.3.1.04.05.03.01.41.03

TIP No.: TIP-0007

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Installation of long-term barrier options with design lives of 500 or more years and extensive side slopes requires very high quality testing to confidently predict design performance. Without the availability of the steep slope barrier, certain CDI Project options will become infeasible.

Regulatory: The applicable regulations will depend on the nature of the waste in each facility. It is expected that all or portions of 40 CFR 264 and 265, 10 CFR 61, and 40 CFR 192 will apply, in addition to DOE Order 5820.2A.

Environmental Safety and Health: The use of surface barriers instead of exhumation or decontamination and collapse of the facilities is estimated to dramatically reduce worker risk.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of up to \$70M (based on the potential costs and savings identified in DOE/RL-2001-29 Draft A). A Record of Decision (ROD) will determine the disposition of the 221-U Facility. A decision to reuse all Hanford materials processing facilities as a waste disposal site could result in a potential cost savings of approximately \$70M. Meeting this technology need will support obtaining a ROD.

Cultural/Stakeholder Concerns: Stakeholders have expressed concern about leaving waste in place, particularly along the Columbia River. Stakeholders have expressed the desire for highly predictive performance testing of barrier designs prior to selection of barriers as remediation options at waste sites.

Other: There are five main processing facilities on the Hanford Site, two at Idaho and one at Savannah River. Technologies that meet the needs of the 221-U Facility will be applicable at these and other similar DOE facilities.

Current Baseline Technology: Current barrier designs for meeting RCRA requirements for landfills use relatively flat side slopes (1:5 to 1:10). However, such a design for the entombment of tall structures, such as a materials processing facility, would be impractical because of the large volume and cost of the required barrier material.

End-User: Waste Management Project, Environmental Restoration Project, Facility Stabilization Project

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-TERM MONITORING FOR CDI

Identification No.: RL-DD052

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Monitoring of LLW Debris (ER-05, risk = 4) and MLLW Debris (ER-02, risk = 4)

TSD Title: N/A

Waste Management Unit: N/A

Facility: Materials processing facilities (five processing canyons)

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Long-term monitoring around and under the 221-U Facility.

Need/Opportunity Category: *Technology opportunity* - the user is interested in the opportunity to improve on the currently identified or planned baseline technology.

Need Description: Technologies are needed to centrally monitor (detect, spatially locate, and quantify) contaminants of concern in the soil around and under the 221-U Facility. Technologies are needed to verify that contaminants are being contained. This need includes the ability to place the monitoring equipment under the facility and under waste that may be placed exterior to the facility. The technology is needed for determining existing conditions as well as detection of contaminant releases in the future.

Schedule Requirements:

Earliest Date Required: A long-term monitoring technology may be needed for operations as early as March 2003.

Latest Date Required: Unknown.

Problem Description: In order to support a Canyon Disposal Initiative (CDI) decision, it must be shown that technologies are available to monitor for contamination release in real-time. It must be shown that the technology can be placed in the areas where contamination leakage is most likely to occur (e.g., directly under the facility and the exterior waste). The needed technology will also be used to set "action levels" and to define corresponding actions. This need relates to function number 3.0 of the CDI Feasibility Study.

Benefit to the Project Baseline of Filling Need: Meeting this need will result in lower monitoring costs and lower potential for environmental contamination.

Functional Performance Requirements: The technologies must be able to detect, locate and quantify the potential contaminants listed in Table 1 to the levels of detection also listed in Table 1. The technologies must be useable in situ, including directly under the facilities that are up to 45 feet below grade and 66 feet wide. The technology must not affect the structural integrity or the seismic loading of the facility. Besides being useable under the facilities, the technology to place the equipment under the facilities is also part of this opportunity statement. The methods must be cost-effective.

The technologies must work in near real-time and must be monitorable from a centralized remote facility. The current centralized monitoring facility is up to 5 miles from one of the material processing facilities.

WBS No.: 1.4.03.3.1.04.05.03.01.41.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: A performance assessment (i.e., an assessment of the ability to perform as a disposal site including monitoring for leaks) is required to support the analysis of the final disposition alternatives for the 221-U Facility.

Regulatory: Final disposition of the 221-U Facility will be determined by a quantitative and qualitative analysis based on the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

Environmental Safety and Health: The ability to determine leaks early will allow for rapid remedial actions and will result in reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$55K. LCC savings estimate is based on the assumption that a waste long-term monitoring technologies would reduce the total operations and management (O&M) costs of the close in place – collapsed structure alternative by 1%. The close in place – collapsed structure (alternative 6) O&M costs are estimated as \$1.1M in DOE/RL-2001-29 Draft A. A Record of Decision (ROD) will determine the disposition of the 221-U Facility.

Cultural/Stakeholder Concerns: Improved protection of the environment and of public health and safety.

Other: There are five main processing facilities on the Hanford Site, two at Idaho, and one at Savannah River. Technologies that meet the needs at the 221-U Facility will be applicable at these and other similar DOE facilities.

Current Baseline Technology: The current technology is to drill monitoring wells surrounding the facility and take measurements on a regular basis.

End-User: Waste Management Project, Environmental Restoration Project, Facility Stabilization Project

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DOE End User/Representative Points of Contact: John Sands, (509) 372-2282, (509) 373-0726, John_P_Sands@rl.gov; Paul Valcich, (509) 373-9947, (509) 373-9838, Paul_J_Valcich@rl.gov

Table 1. Contaminants of Concern in Solids

Contaminant of Concern	Detection Limits*
Acids	0.1
Ammonium Fluoride - NH ₄ F	0.2
Hexone	0.002
Nitrates - Al(NO ₃) ₃ , NaNO ₃ , NH ₄ NO ₃ , HNO ₃	0.1
Kerosene, Normal Paraffin Hydrocarbon	5
Lead	0.4
PCBs	0.05
Phosphoric Acid - H ₃ PO ₄	2
Sodium Dichromate	0.5
Sodium Nitrite - NaNO ₂	0.1
Sulfates - HSO ₄ , Na ₂ SO ₄ , Fe(NH ₄) ₂ (SO ₄) ₂	2
Tributyl Phosphate	0.5
Am-241	1
Co-60	0.1
Cs-137	0.1
Eu-152	0.1
Eu-154	0.1
Np-237	1
Pu-238, Pu-239/240	1
Sr-90	1
Th-232	1
U-234, U-235, U-238	1
Gross alpha	10
Gross beta	15

* Detection limits are for full protocol. Current onsite capability is generally orders of magnitude worse. Values are pCi/g or mg/Kg.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

OPERATIONAL MODELING FOR CDI

Identification No.: RL-DD053

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Computer Modeling

TSD Title: N/A

Waste Management Unit: N/A

Facility: Materials processing facilities (five processing canyons)

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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Need Title: Computerized modeling for facility planning, operation, and waste loading and tracking for the Canyon Disposition Initiative (CDI) Project.

Need/Opportunity Category: *Technology opportunity* - the user is interested in the opportunity to improve on the currently identified or planned baseline technology.

Need Description: Facility modeling for facility planning, operation, and waste loading and tracking will be necessary if the 221-U Facility is operated as a disposal facility. There is a need to virtually model the facility, contents, and proposed waste inventory to optimize facility space and loading, ensure safe disposal, and record contents.

Schedule Requirements:

Earliest Date Required: Modeling software may be needed for operations as early as March 2003.

Latest Date Required: Unknown.

Problem Description: If used for waste disposal, space in the 221-U Facility will need to be optimized. This must be done safely, and at a reasonable cost. This need relates to function number 2.0 of the CDI Feasibility Study.

Benefit to the Project Baseline of Filling Need: Meeting this need would result in the optimal waste loading and use of the facility, thereby reducing overall cost.

Functional Performance Requirements: The modeling software must incorporate all facility components including available facility resources (overhead cranes), incorporate structural loading and capacity, identify existing equipment, and track waste to be introduced into the facility for disposal. Input data will come from facility drawings, photographs, laser range finders, gamma cameras, site databases, waste

inventories, and/or computer aided design (CAD) packages. The tool will be used to plan and test (simulate) waste loading methodologies to maximize the safe storage of waste in the facility, to track progress in the facility as waste is interred, and to document the inventory (identification, location, dose rate, dimension, weight, etc.) of the facility contents. Report generation is a requirement for the software so that a hard copy file may be maintained.

WBS No.: 1.4.03.3.1.04.05.03.01.41.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Waste disposal space in the 221-U Facility needs to be maximized. Prior to waste delivery to the facility, task planning (simulation) will ensure that the waste is staged optimally in the facility according to the facility requirements (structural), waste type, size, contamination level, etc., prior to any equipment movement in the facility.

Regulatory: RCRA disposal site requirements.

Environmental Safety and Health: Optimized space and loading methods determined through simulations will result in reduced exposure and ensure the safe permanent disposal of waste.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$5.5K. LCC savings estimate is based on the assumption that operational modeling would reduce the total operations and management (O&M) costs of the close in place – collapsed structure alternative by 0.1%. The close in place – collapsed structure (alternative 6) O&M costs are estimated as \$1.1M in DOE/RL-2001-29 Draft A. The optimal use of space in this facility will minimize the need for further disposal facility space in other locations.

Cultural/Stakeholder Concerns: Improved protection of the environment and of public health and safety.

Other: There are five main processing facilities on the Hanford Site, two at Idaho, and one at Savannah River. Methodologies developed for use at the 221-U Facility will be applicable at these and other similar DOE facilities.

Current Baseline Technology: Standard facility operational planning.

End-User: Waste Management Project, Environmental Restoration Project, Facility Stabilization Project

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DOE End User/Representative Points of Contact: John Sands, (509) 372-2282, (509) 373-0726, John_P_Sands@rl.gov; Paul Valcich, (509) 373-9947, (509) 373-9838, Paul_J_Valcich@rl.gov

Additional Surveillance and Maintenance

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE MONITORING SYSTEM UPGRADES FOR THE S&M PROGRAM

Identification No.: RL-DD055

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: All facilities in long term S&M

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

- ☐ 1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC)
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote monitoring system upgrades for the Surveillance and Maintenance Program.

Need/Opportunity Category: Technology opportunity; the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: As technology progresses, the remote monitoring system can be improved to save money and increase capability. Upgrades may include modification of software, hardware, such as computer upgrades or the use of fiber optics, or conversion to a new system.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 9/30/2046

Problem Description: The problem is one of upgrading the current system with improved technology.

Benefit to the Project Baseline of Filling Need: Meeting this need would result in the system not becoming obsolete over time.

Functional Performance Requirements: Software and system components must be compatible with the current system or replace the current system. Potential upgrades include additional control features, Microsoft Windows operating system, local area network accessibility, increased functions and better (more reliable) equipment.

WBS No.: 1.4.03.5.1.01.07.01.02

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Upgrades will increase efficiency and output of the system.

Regulatory: Regulations require the control of contamination. For facilities in surveillance and maintenance, control of contamination is accomplished by monitoring the facilities and maintaining them as needed.

Environmental Safety and Health: Contamination control is needed to reduce the risk of an environmental release. Remote monitoring also reduces the risk to personnel who would otherwise be required to enter the facilities for inspection.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$10M. LCC savings estimate is based on the assumption that remote monitoring system upgrades would save approximately 1 person year per year for 100 years at a cost of \$100K per person year. A remote monitoring system is less costly to operate than scheduling and performing regular inspections of the facilities.

Cultural/Stakeholder Concerns: Maintaining facilities in a cost-effective manner is a stakeholder concern.

Other: None identified.

Current Baseline Technology: Siemens programmable logic control units, dedicated phone lines, fiber optic lines, and a personal computer.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-LIVED ROOF REPLACEMENT FOR THE S&M PROGRAM

Identification No.: RL-DD057

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: PUREX

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Replacement roof of long-lived construction for the S&M Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Cost-effective alternatives to the current baseline roof replacement methods are desired.

Schedule Requirements:

Earliest Date Required: Roofing is an ongoing need.

Latest Date Required: Roofing is an ongoing need.

Problem Description: Facilities' require reroofing over time. For example, there are five large process facilities with flat concrete roofs that require reproofing approximately every 20 years.

Benefit to the Project Baseline of Filling Need: A new roof for a facility that would not have to be replaced again prior to D&D could save up to \$1.5M per roof for a process facility (assuming the baseline roof would only have to be replaced once more with the current methods prior to D&D). Given that all five large process facilities will require reroofing in the near future, cost savings potential at Hanford is \$7.5M.

Functional Performance Requirements: The roof must withstand the local winds (up to 60+ MPH), have a greater than 20 year design life, and require little or no maintenance over the design life period. It is desirable to find a replacement to the current flat roof. Any alternative should perform at least as well as the planned polyurethane foam covered with a acrylic overcoat and be able to be applied to form a slight pitch on a large flat/concave surface. The five process facility roofs to be repaired are constructed of

poured in place concrete covered with asphalt and pea gravel and are approximately 1,000 feet by 80 feet in size.

WBS No.: 1.4.03.3.1.02.05.03 and 1.4.03.3.1.01.05.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Current roofing methods using asphalt are not effective for large, unheated facilities. Contraction and expansion during seasonal change result in cracks forming in the expansion joints that allow water infiltration.

Regulatory: N/A

Environmental Safety and Health: Roof maintenance ensures containment and prevents the spread of contamination.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$10M. LCC savings estimate is based on the assumption that one re-roofing would be averted per process facility. Assuming that the cost to re-roof each process facility is similar, the Project estimated the cost of roof replacement a process facility to be over \$1.5M. Given that all five large process facilities will require roof upgrades in the near future, cost savings potential at Hanford is \$7.5M. There are a total of eight canyons throughout the DOE Complex for a savings of roughly \$10M.

Cultural/Stakeholder Concerns: Maintaining facilities in a cost-effective manner is a stakeholder concern.

Other: None identified.

Current Baseline Technology: Two methods are currently employed at the Hanford Site: asphalt covered with pea gravel, membranes, and polyurethane foams. The foams have not been used on the large process facilities because the adhesion may be broken by wind shear. The current plan is to apply polyurethane foam with an acrylic overcoat. Asphalt and gravel are not adequate for unheated facilities.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

METHOD TO CONTROL DEEP ROOTED PLANTS FOR THE S&M PROGRAM

Identification No.: RL-DD058

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW Soil (ER-04, risk = 3 and ER-14, risk = 5)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: Soils around various facilities

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Method to control deep rooted plants for the Surveillance and Maintenance Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: A cost-effective method of controlling the growth of deep-rooted plants (e.g., Russian Thistle) is needed. The method would be used for areas of contaminated soil maintained by the outdoor surveillance and maintenance program.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 9/30/2046

Problem Description: Deep rooted plants, if allowed to grow on contaminated areas, take up contamination from contaminated soil that has been covered by 2 feet of clean soil for stabilization. Some of the local plants (e.g., Russian Thistle/tumbleweed) are short lived and are blown around after dying. Such plants carry absorbed water soluble, radiological contamination, causing contamination to be spread.

Benefit to the Project Baseline of Filling Need: Meeting this need would result in a potential cost savings of a maximum of \$500K per year.

Functional Performance Requirements: The method must inhibit the growth of local deep-rooted plants for a total cost, including application cost, of less than \$110/acre/year. The method must keep plant roots from entering contaminated soil, which is approximately 2 feet below grade.

WBS No.: 1.4.03.3.1.04.05.01.01.34.02

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Control of deep rooted plants is needed so that contamination will be contained and not spread to uncontaminated areas.

Regulatory: None identified.

Environmental Safety and Health: Contamination spread could affect the safety and health of workers and the population surrounding the Hanford Site.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$20M. LCC savings estimate is based on the assumption that a method to control deep rooted plants would negate the need of herbicide treatments that have an annual budget of \$500K. S&M Program completion is scheduled for 2046.

Cultural/Stakeholder Concerns: Contamination spread is a stakeholder concern.

Other: None identified.

Current Baseline Technology: An area of contaminated soil is currently consolidated and then covered with 2 feet of clean soil for interim stabilization. The S&M Program then maintains the area by applying herbicides as needed throughout the year to prevent deep-rooted plant growth.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, reggge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LEAD DECONTAMINATION FOR THE S&M PROGRAM

Identification No.: RL-DD059

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-RC01

Waste Stream: LLW (ER-05, risk = 4) and MLLW lead (ER-02, risk = 4)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

- ☐ 1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC)
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Decontamination of surface contaminated lead for the Surveillance and Maintenance Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Approximately one hundred thousand pounds of surface contaminated lead will have to be disposed of during decommissioning at the Hanford Site. Some of the lead was mined prior to the use of nuclear devices and may be useable for shielding in counters where background needs to be shielded. The lead is currently slated for micro-encapsulation and burial at the Environmental Restoration Disposal Facility (ERDF).

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 9/30/2046

Problem Description: Approximately one hundred thousand pounds of surface contaminated lead will have to be disposed of during decommissioning at the Hanford Site. With the current desire to reuse and recycle material, it is desirable to find a cost-effective alternative to disposition for the lead.

Benefit to the Project Baseline of Filling Need: Meeting this need would result in reuse of lead and reduction of waste.

Functional Performance Requirements: The lead must be decontaminated to free release for less than \$60/ton (\$0.165 per pound).

WBS No.: 1.4.03.1.1.08.05.02.01

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Current methods are not cost-effective for reducing the waste volumes of radioactively contaminated lead.

Regulatory: Free release criteria would apply.

Environmental Safety & Health: Long-term liability (potential for a release) could be reduced with recycling and reuse of materials.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$100K for the DOE Complex, including an ROM cost savings of \$20K at the Hanford Site. LCC savings estimate is based on the assumption that Rocky Flats, the Idaho National Engineering and Environmental Laboratory, the Oak Ridge National Laboratory, Fernald and the Savannah River Site would all realize similar savings to the Hanford Site. The Hanford Site estimate is based on there being approximately 100K pounds of lead on site (Project estimate) that costs \$0.165/pound for micro-encapsulation and disposal (Project cost). Additional cost savings might be realized by recycling (e.g., the cost to make a drum from recycled material is less costly than to buy a new drum).

Cultural/Stakeholder Concerns: Reduced waste volumes placed in the ground will result in reduced long-term liability. Also, because lead is a land-banned material pretreatment is required prior to disposal.

Other: None identified.

Current Baseline Technology: Micro-encapsulation and burial at ERDF.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

METHOD FOR PERFORMING ROOF INSPECTIONS FOR THE S&M PROGRAM

Identification No.: RL-DD067

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: All facilities in S&M

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Method for performing roof inspections for the Surveillance and Maintenance (S&M) Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: An improved method is needed to inspect the condition of aging roofs and to collect data to feed the U.S. Army Corps of Engineer Roof Integrity Model.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: This is an ongoing need.

Problem Description: As facilities age, roof integrity decreases and may result in unsafe conditions for manual inspection. Therefore, a means of inspecting the roofs without requiring a manual inspection is desired.

Benefit to the Project Baseline of Filling Need: Meeting this need will result in increased worker safety.

Functional Performance Requirements: The method should not involve access by personnel on the aging roof and must be able to provide information similar to a roofing expert's visual inspection. The collected information must be sufficient as input to a Corps of Engineers' model used for determining roof integrity

WBS No.: 1.4.03.3.1.02.05.03 and 1.4.03.3.1.01.05.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Current methods can become dangerous to personnel as roof conditions deteriorate over time.

Regulatory: None known.

Environmental Safety & Health: Aging roofs pose a safety hazard for inspecting personnel.

Cost Savings Potential (Mortgage Reduction): Unknown. Cost savings would be expected in injuries prevented and lives saved.

Cultural/Stakeholder Concerns: Improved inspection methods would result in greater worker safety and would reduce the potential for contamination releases associated with aging roofs.

Other: None identified.

Current Baseline Technology: Manual inspection of each roof.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NEW LUBRICANTS FOR THE S&M PROGRAM

Identification No.: RL-DD068

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: All facilities with active ventilation

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: New lubricants for rotating equipment that support the Surveillance and Maintenance (S&M) Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Operating equipment addressed by this need consists of ventilation equipment, such as exhaust fans and air compressors, used to maintain negative pressure within contaminated facilities. Much of the equipment is past its expected operating life, but continues to aid in maintaining safe conditions within buildings. New lubricants are needed to further extend the life of the equipment in order to avoid the cost of equipment replacement in facilities awaiting decommissioning.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: This is an ongoing need.

Problem Description: The operating equipment in the S&M Program (i.e., exhaust fans and air compressors) are approximately 50 years old and will be run to failure. However, the operating systems are needed to maintain safe conditions within the facilities of the S&M Program. Prolonging the lives of the current equipment will avoid the need to replace equipment on facilities that will be entering the decommissioning program.

Benefit to the Project Baseline of Filling Need: Meeting this need results in minimizing the risk of contamination release and in avoiding the cost of equipment replacement.

Functional Performance Requirements: Lubricants must have a minimum expected life of six months.

WBS No.: 1.4.03.3.1.02.05.03 and 1.4.03.3.1.01.05.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Some of the operating equipment has been operating continuously for approximately 50 years.

Regulatory: TPA requires maintaining equipment and facilities in a safe condition until final disposition can be achieved.

Environmental Safety & Health: Maintaining proper ventilation minimizes the potential for contaminant release.

Cost Savings Potential (Mortgage Reduction): The rough order of magnitude (ROM) potential life cycle cost (LCC) savings associated with lubrication of the fans is \$1M. The LCC savings estimate is based upon the assumption that the number of lubrications per year could be reduced by half, an annual cost of \$50K for the current lubricating schedule (estimated by the project), accumulated over 46 years of surveillance and maintenance. The cost of replacing equipment would also be avoided, but has not been included in the LCC estimate.

Cultural/Stakeholder Concerns: Loss of ventilation may result in loss of contamination containment.

Other: None identified.

Current Baseline Technology: Silicone based lubricants/greases

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CAISSON SEALING METHOD FOR THE S&M PROGRAM

Identification No.: RL-DD070

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW liquid

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: REDOX and PUREX

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Caisson sealing method for the S&M Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: There are two caissons, each with a sump and seal-pot vessel. The vessels collect water that enters them from rainfall or other natural occurrences. A technology is needed to seal the caissons to prevent water intrusion.

Schedule Requirements:

Earliest Date Required: FY 2002

Latest Date Required: Unknown.

Problem Description: There are two buried caissons that each contains a sump and a seal-pot vessel. It is believed that the negative pressure maintained within the caissons draws water from the soil into the caissons and then keeps the water from flowing out of the caissons. No water has been detected between the vessels and caisson walls; however, it is desirable to seal the caissons against possible water intrusion as the concrete ages.

Benefit to the Project Baseline of Filling Need: Monitoring, water draining and water treatment costs could be reduced or avoided.

Functional Performance Requirements: The technology must be able to seal the buried concrete caissons without loss of integrity to the caissons. If sealing is performed inside the caissons, it must be performed remotely through an 8" entry pipe and must maintain a seal in a negative pressure environment.

WBS No.: 1.4.03.3.1.02.05.03 and 1.4.03.3.1.01.05.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: A technology is needed to reduce the generation of additional radioactive waste.

Regulatory: None known.

Environmental Safety & Health: Eliminating the pumping and disposal of fluids avoids the potential for leaks to the environment.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings is \$1M. LCC savings estimate is based on budget of \$70K every three years for one caisson and a budget of \$70K every 10 years for the second caisson. The S&M mission completion date is 2046 (average annual cost of \$30.33K). The cost of draining and treating the water could be avoided with proper sealing of the caissons.

Cultural/Stakeholder Concerns: Water intrusion into the caissons increases the potential for a release to the environment if the negative pressure fails.

Other: None identified.

Current Baseline Technology: Monitoring for water intrusion, and draining and treating water as needed.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

Contractor Facility/Project Manager: Jerry McGuire, BHI, (509) 373-7253, (509) 373-4509, jjmcguir@bhi-erc.com

DOE End User/Representative Points of Contact: John Sands, (509) 372-2282, (509) 373-0726, John_P_Sands@rl.gov; Paul Valcich, (509) 373-9947, (509) 373-9838, Paul_J_Valcich@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

METHOD TO PRESERVE B REACTOR EXTERIOR DUCTWORK FOR THE S&M PROGRAM

Identification No.: RL-DD071

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-RC01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 105-B

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Method to preserve the B Reactor exterior ductwork for the Surveillance and Maintenance (S&M) Program.

Need/Opportunity Category: *Technology need* - there is no existing or currently identified technology capable of meeting the project's need (i.e., no baseline approach has been identified).

Need Description: The ductwork and associated flashing are failing on the B Reactor. Due to the facility's historical significance, it is desired that the visual appearance of the B Reactor be maintained.

Schedule Requirements:

Earliest Date Required: FY 2002

Latest Date Required: Unknown.

Problem Description: The ductwork at B Reactor was protected by an asbestos coating until it was removed 18 years ago. Since then, the ductwork and flashing have corroded to the point that they are a safety concern in the high winds that are experienced on a regular basis. Due to the historical significance of the facility and the prominence of the ductwork, removal of the ductwork may not be allowed without replacement of like-kind material or an aesthetically acceptable solution.

Benefit to the Project Baseline of Filling Need: Preservation of a national historical landmark and assurance of visitor safety.

Functional Performance Requirements: The technology must meet all historical landmark requirements, protect the ductwork and flashing from further deterioration, and maintain safety in high winds (i.e., keep ductwork/sections of ductwork from becoming disconnected in high winds).

WBS No.: 1.4.03.1.1.02.05.02.01.41

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Preservation/replacement of the ductwork at B Reactor.

Regulatory: Regulations related to historical landmarks.

Environmental Safety & Health: Segments of ductwork that may become disconnected due to high winds pose a safety hazard to visitors of the B Reactor.

Cost Savings Potential (Mortgage Reduction): N/A.

Cultural/Stakeholder Concerns: Two concerns are maintaining a historical landmark and ensuring the safety of visitors.

Other: None identified.

Current Baseline Technology: None.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SEALANT FOR VALVES CONTAINING NITRIC ACID FOR THE S&M PROGRAM

Identification No.: RL-DD084

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 202-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Sealant for Valves Containing Nitric Acid for the S&M Program.

Need/Opportunity Category: *Technology need* - there is no existing or currently identified technology capable of meeting the project's need (i.e., no baseline approach has been identified).

Need Description: The REDOX plutonium loadout hood has a leaking flanged valve containing nitric acid with plutonium. The valve requires encapsulation to contain any potential leaks. Other valves at the Site may have a similar need to be addressed in the future.

Schedule Requirements:

Earliest Date Required: FY 2002

Latest Date Required: Unknown.

Problem Description: The REDOX plutonium loadout hood project has a leaking flanged valve that requires encapsulation. The REDOX valve is a standard four bolt weld neck flange. Similar valves exist at all the processing facilities. The nitric acid in the REDOX valve is a 2% concentration with a pH of 1.8.

Benefit to the Project Baseline of Filling Need: Assured containment of plutonium/nitric acid combination.

Functional Performance Requirements: The technology must be able to be applied over uncleaned valves with potential wet spots of 5-10% solution of nitric acid. The application equipment must be operable in a radiation zone while sleeved or must be easy to decontaminate. The material must have a 25-year life under contact with nitric acid (5-10% solution possible).

WBS No.: 1.4.03.3.1.02.06.03.10.42

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Encapsulation reduces the risk of a release of plutonium to the remainder of the facility or to the environment.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety & Health: An improved method could reduce worker exposure and the spread of contamination.

Cost Savings Potential (Mortgage Reduction): Unknown.

Cultural/Stakeholder Concerns: An encapsulant would reduce the risk of an environmental release.

Other: None identified.

Current Baseline Technology: None.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-DESTRUCTIVE EXAMINATION AND ASSAYING TECHNIQUES FOR LEGACY WASTE BOX CHARACTERIZATION FOR THE S&M PROGRAM

Identification No.: RL-DD085

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: HAN02

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 212-N

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Non-Destructive Examination and Assaying Techniques for Legacy Waste Box Characterization for the S&M Program.

Need/Opportunity Category: *Technology need* - there is no existing or currently identified technology capable of meeting the project's need (i.e., no baseline approach has been identified).

Need Description: There are fifteen wooden boxes of suspect transuranic (TRU) waste stored at 212-N. The fifteen boxes must be characterized to determine the proper waste disposal paths.

Schedule Requirements:

Earliest Date Required: FY 2002

Latest Date Required: FY2002.

Problem Description: Fifteen wooden boxes of waste were stored in the 212-N Facility in the early 1970's. Records indicate the waste material is probably gloveboxes, glovebox equipment and glovebox waste. The records indicate the waste material contains plutonium and uranium, however, there is no record of other potential radionuclides or hazardous waste. The boxes were placed in storage when the definition of transuranic waste was 100 nCi/gm. Some of the waste may be reclassified under the current definition of transuranic waste. If the boxes cannot be classified without opening the boxes, each box will be opened, the contents size reduced and repackaged, the repackaged waste will be assayed. The waste handling will have to be performed assuming worst case conditions for personnel safety.

Benefit to the Project Baseline of Filling Need: The boxes may be sorted into low level or transuranic waste without opening the boxes using NDA and NDE techniques, thereby improving worker safety. Non-destructive examination (NDE) would also provide information on the boxes requiring repackaging

(i.e., TRU waste) so that worker safety would be increased even for the boxes to be opened and repackaged,

Functional Performance Requirements: The technologies must be transportable. The technologies must provide NDE and NDA capabilities sufficient to define waste disposal path without further waste handling. The technologies must be operable on wooden boxes that range in size from 4' 9" X 8' X 4' 7" (H) to 7' 10" X 16' 10" X 15' 10" (H). It is desirable to perform the characterization of all fifteen boxes directly outside the 212-N Building in a contamination control structure (to be built).

WBS No.: 1.4.03.3.1.04.05.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Characterization of waste to determine the proper waste disposal path.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety & Health: Less waste handling will result in reduced risk of an environmental release and increased worker safety.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings is \$1M. LCC savings estimate is based on a ROM of \$1.8M to perform the opening of the boxes, sampling, visual inspection, radiation survey and data analysis that would be required if NDA/NDE techniques are unavailable versus a ROM of \$730K to perform NDA/NDE and dispose of fourteen of the boxes as low level waste. The fifteenth box is assumed to be transuranic waste and would require opening, characterization, dismantling and repackaging.

Cultural/Stakeholder Concerns: Less waste handling will result in reduced risk of an environmental release.

Other: None identified.

Current Baseline Technology: None for characterizing the boxes without opening and repackaging the waste.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMEDIATION OF HEXONE TANKS FOR THE S&M PROGRAM

Identification No.: RL-DD086

Date: August 2001

Program: Surveillance and Maintenance

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-CP01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 212-N

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒	1. Critical to the success of the Accelerated Cleanup: Paths to Closure (ACPC) 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remediation Of Hexone Tanks For The S&M Program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: There are two horizontal underground hexone tanks that are planned for remediation by the end of March 2002.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 3/31/2002.

Problem Description: There are two buried hexone tanks (236-S, Tanks 141 and 142) that need to be remediated. The tanks are 26 feet long and eleven and a half feet in diameter. There is four feet of overburden. The entry points are a 4-inch diameter pipe roughly 10 feet from the end of each of the tanks and a manhole access toward the opposite end of each tank. The tanks contain approximately 250 gallons of sludge composed primarily of hexone. Hexone is explosive. An inert environment of less than 11% oxygen is maintained for both tanks.

Benefit to the Project Baseline of Filling Need: Potential for cost savings.

Functional Performance Requirements: The technologies must be able to immobilize the hexone sludge and fill the void space in the tanks. The material used must not deteriorate over time and must be able to support heavy equipment. The technology must use the available entry points into the tanks.

WBS No.: 1.4.03.3.1.02.05.03

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-030

Justification for Need:

Technical: Remediation of the hexone tanks to decrease the potential for an environmental release.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety & Health: Tank remediation will result in reduced risk of an environmental release and increased worker safety.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings is \$20K. LCC savings estimate is based on the assumption that 10% of the total interim stabilization costs could be saved and that the projected costs for stabilization is estimated as \$187K (BHI-01521 Draft B).

Cultural/Stakeholder Concerns: Remediation will result in reduced risk of an environmental release.

Other: None identified.

Current Baseline Technology: Low density grout is planned.

End User: Environmental Restoration Project

Site Technical Point-of-Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Bob Egge, BHI, (509) 373-2774, (509) 373-7711, rgegge@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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233-S Plutonium Concentration Facility Decommissioning Project

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CUTTING PLUTONIUM CONTAMINATED PIPE FOR 233-S

Identification No.: RL-DD030

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Cutting LLW debris (ER-05, risk = 4) and TRU debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 233-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: A Safe Method for Cutting Plutonium Contaminated Pipe for 233-S.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Alternative cutting methods are required for various sizes of piping with internal dispersible and fixed plutonium contamination. The pipes are in congested areas that inhibit the use of glove bags for contamination control. The piping to be cut ranges from standard gauge stainless steel to non-standard diameter, rolled tantalum and titanium alloys with less than 8-inch outside diameters. Pipe diameters of 4-inches and greater are considered process vessels and can be double walled with other internal items.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 12/31/2004

Problem Description: Piping will be removed during the course of the 233-S Facility decommissioning project. Alternative methods are needed to safely cut piping that may contain removable plutonium. The piping will be sampled and vented prior to sectioning. However, there is concern that removable contamination will be released within the work area during cutting operations.

Benefit to the Project Baseline of Filling Need: Confinement will not be required reducing the potential of schedule delays and unplanned costs. Alternative cutting methods could remove the workers from current hazards and reduce manpower requirements.

Functional Performance Requirements: The piping to be cut range in size from 0.5 inch to 7.0 inch OD and are constructed of schedule 10 or schedule 40 stainless steel or titanium. Some of the piping has eight-inch jackets and some of the jackets are lead. Piping may be vertical or horizontal, free standing or against walls or floors, and in congested areas at elevated locations. Condensers, which are considered part of the process piping, contain one-inch diameter tubes.

WBS No.: 1.4.03.3.1.02.06.03.10.42.01

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: Current baseline technologies do not provide a mechanism for preventing spread of contamination.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety & Health: If contamination spread occurred within the work area during cutting, then worker exposure risk would be increased.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$200K. LCC savings estimate is based on the assumption that pipe cutting technologies would reduce the FY2002 and FY2003 costs by 2%. The FY2002/2003 Project cost of \$10.7M was assumed based on DOR/RL-97-44, Volume 5, Revision3, September 2000. If no additional methods are found, then additional confinements will have to be designed and constructed causing delays and unplanned expense.

Cultural/Stakeholder Concerns: Stakeholders are very interested in assuring the safety of the general population and in the general cleanup of the Hanford Site. Potential release to the environment would be unacceptable to the stakeholders.

Other: None identified.

Current Baseline Technology: The baselines for cutting pipes are standard cutting tools such as powered reciprocating saws, band saws and hydraulic crimp-and-shear tools. However, the baseline technologies do not provide a mechanism for preventing the spread of dispersible and fixed contamination.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; George Carter, BHI, (509) 373-2141, 373-6562, gicarter@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

Contractor Facility/Project Manager: Allan Chaloupka, BHI, (509) 373-1369, (509) 373-6562, abchalou@bhi-erc.com

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-INTRUSIVE DETECTION OF PIPE CONTENTS FOR 233-S

Identification No.: RL-DD031

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Detection of HAZ gases (no waste stream)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 233-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Non-Intrusive Detection of Pipe Contents for 233-S.

Need/Opportunity Category: Technology opportunity; the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Pipes in 233-S must be breached to detect liquids prior to dismantling for disposal. Drilling methods cause heat and could cause sparking. A non-intrusive method to detect liquids or explosive gases in closed piping systems is needed.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 10/1/2002

Problem Description: Pipes in 233-S must be breached to detect liquids or explosive gases prior to disposal. Drilling methods cause heat and present possible increased risk during breaching. The majority of the piping and vessels are inaccessible without extended reach tools and man-lifts using tapping devices.

Benefit to the Project Baseline of Filling Need: Meeting this need could reduce the potential hazards associated with sampling closed piping systems for liquids or explosive gases.

Functional Performance Requirements: The technology must be able to detect liquids or explosive gases (e.g., H₂) through 1.0-inch - 7.0 inch OD schedule 10 and schedule 40 steel piping. The piping may be free standing, against walls or along floors, and may be in congested areas.

WBS No.: 1.4.03.3.1.02.06.03.10.42.01

TIP No. : N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: No non-intrusive means has been found to detect liquids or explosive gases in a closed piping system.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety & Health: Reduce the potential hazards associated with sampling closed piping systems for liquids or explosive gases.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$200K. LCC savings estimate is based on the assumption that non-intrusive detection technologies would reduce the FY2002 and FY2003 costs by 2%. The FY2002/2003 Project cost of \$10.7M was assumed based on DOR/RL-97-44, Volume 5, Revision 3, September 2000. If it can be verified through non-intrusive means that no liquids or explosive gases are present within a closed pipe, the need to conduct additional sampling could be eliminated.

Cultural/Stakeholder Concerns: Stakeholders are very interested in assuring the safety of the general population and in the general cleanup of the Hanford Site. Potential release to the environment would be unacceptable to the stakeholders.

Other: None identified.

Current Baseline Technology: If there are valves or flanges, the pipes can be sampled for analysis. If none of these access points exist, no non-intrusive detection methods are known. The current method is to drill through the top of the piping at low points (where liquid would be expected to accumulate). A wooden dowel that has been dipped in a paste is inserted to the bottom of the pipe. The paste changes color when contacting water.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; George Carter, BHI, (509) 373-2141, 373-6562, gjcarter@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

Contractor Facility/Project Manager: Allan Chaloupka, BHI, (509) 373-1369, (509) 373-6562, abchalou@bhi-erc.com

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTAMINATION FIXATIVE FOR 233-S

Identification No.: RL-DD032

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Fixatives for LLW debris (ER-05, risk = 4) and TRU debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 233-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Contamination Fixative for 233-S.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: A fixative is needed to capture airborne and removable contamination and affix contamination on facility surfaces and within piping and vessels.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 12/31/2004

Problem Description: Areas of airborne and removable contamination must be contained; e.g., affix contamination on surfaces and within piping and vessels. The baseline technology is able to affix loose and airborne contamination to surfaces. However, the final surface (water) is wet and may result in the transfer of contamination from surfaces to personnel protective equipment. Also, the method will not work if there is unfavorable airflow.

Benefit to the Project Baseline of Filling Need: An improved method could expedite clean-up activities with increased safety and lower costs.

Functional Performance Requirements: A method is needed to affix loose and airborne contamination to surfaces. The method should be easy to apply, have some indicator for wet/dry, should not be wet or tacky upon curing (if applicable), be able to coat grating, and be able to coat the interior of 1.0 inch to 7.0 inch OD pipes. The method should be applicable with some airflow in contained areas. The method should

also be useable on the exterior of piping and vessels in a confined area. The method should not offgas flammable/explosive gases in quantities sufficient to become a hazard.

WBS No.: 1.4.03.3.1.02.06.03.10.42.01

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: The baseline method leaves the surface wet and may result in the transfer of contamination from surfaces to personnel protective equipment. Also, the method will not work if there is unfavorable airflow.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety & Health: An improved method could reduce worker exposure and the spread of contamination.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$100K. LCC savings estimate is based on the assumption that improved fixatives would reduce the FY2002 and FY2003 costs by 1%. The FY2002/2003 Project cost of \$10.7M was assumed based on DOR/RL-97-44, Volume 5, Revision3, September 2000. Personnel time would be saved if only one coating is required to affix airborne and loose contamination.

Cultural/Stakeholder Concerns: An improved method could expedite clean-up activities with increased safety and lower costs.

Other: None identified.

Current Baseline Technology: The current methods include a latex-based fixative and the use of continuous water misting on piping and vessels exteriors and on walls and floors. Water misting should keep airborne contamination to a minimum, but will allow for easy pick up and spread of contamination as loose contamination will not be contained. There is no baseline fixative for piping interiors.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; George Carter, BHI, (509) 373-2141, 373-6562, gjcarter@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

Contractor Facility/Project Manager: Allan Chaloupka, BHI, (509) 373-1369, (509) 373-6562, abchalou@bhi-erc.com

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CHARACTERIZATION FOR WASTE HANDLING, PACKAGING AND PROCESSING FOR 233-S

Identification No.: RL-DD060

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Characterization of LLW debris (ER-05, risk = 4) and TRU debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 233-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Characterization system for waste handling, packaging and processing at 233-S.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: A system is needed to provide an electronic means of tracking waste material, characterizing material as it is being packaged and providing a criticality go/no-go for packaging. In addition, waste that is below criticality quantity concerns needs to be screened to determine if either low-level or transuranic levels are present. Due to the rigor required for transuranic waste documentation, the waste tracking system is required to track waste component characterization and physical property information.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 12/31/2004

Problem Description: Waste streams expected from decommissioning 233-S include low-level waste, hazardous waste, mixed waste, transuranic (TRU) waste, TRU-mixed waste, non-hazardous/non-radioactive waste, and recyclable and excessable waste. Waste separation and segregation are planned to minimize waste.

Benefit to the Project Baseline of Filling Need: Cost savings could result by being able to properly segregate materials, surfaces and equipment so that the proper, least-cost disposal methods are used.

Functional Performance Requirements: The system must provide an electronic means of tracking waste material, real-time characterization of material as it is being packaged, a criticality go/no-go for packaging, and a signal when the maximum 100 gm limit for plutonium loading has been exceeded. All material must be non-destructively assayed to a 95% upper confidence level. The system must alleviate the need to package prior to characterizing to avoid the current need to unpackage and decontaminate. Real-time characterization of the waste is required to allow for rapid segregation and separation on an item-by-item basis.

WBS No.: 1.4.03.3.1.02.06.03.10.42.01

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: A rapid means to segregate materials with the proper characterization of wastes will lead to waste minimization.

Regulatory: Segregation is needed to meet waste disposal requirements.

Environmental Safety and Health: Improved worker safety could result with the use of remote systems.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$200K. LCC savings estimate is based on the assumption that waste characterization technologies would reduce the FY2002 and FY2003 costs by 2%. The FY2002/2003 Project cost of \$10.7M was assumed based on DOR/RL-97-44, Volume 5, Revision 3, September 2000. Significant costs savings could result by being able to properly segregate materials, surfaces and equipment so that the proper, least-cost disposal methods are used.

Cultural/Stakeholder Concerns: Reduction in handling and the amount of materials to be handled, stored or disposed as a waste product is desired.

Other: None identified

Current Baseline Technology: Segregation is accomplished by hand, using standard characterization methods (e.g., wipes, laboratory analysis, radiation detection - both general and energy specific such as gamma spectral analyses). An alternative is management of material as contaminated based on process knowledge.

End-User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; George Carter, BHI, (509) 373-2141, 373-6562, gicarter@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

METHOD TO CAPTURE/CONTAIN AIRBORNE ALPHA CONTAMINATION FOR 233-S

Identification No.: RL-DD062

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW debris (ER-05, risk = 4) and TRU debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 233-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

- X 1. Critical to the success of the ACPC
- _____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- _____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: A method to capture/contain airborne alpha contamination (e.g., plutonium) from work areas at 233-S.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Decommissioning is being performed in areas with airborne alpha contamination that poses a safety concern for the workers. Much of the work is performed using glove bags that are cumbersome. A "bug-zapper-like" curtain or wall could be used to decrease airborne contamination by attracting and capturing the contamination. Airborne contamination and the likelihood of a release would be reduced with such a system. (Note that work had been started on such a device by the D&D Integrated Demonstration at INEEL, however, the activity was terminated.)

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 12/31/2004.

Problem Description: Much of the decommissioning work at 233-S must be performed in areas with airborne alpha contamination. This requires special personnel protection and means of protecting the environment from an unintentional release. For example, pipe cutting in a trench required the construction of a glovebag, a tent, and the use of personnel protective equipment.

Benefit to the Project Baseline of Filling Need: Worker safety will be enhanced and the potential of an environmental release will be decreased by meeting this need.

Functional Performance Requirements: As a minimum, the system must contain airborne isotopes, but a system to attract and capture airborne isotopes is desired. The system must pose no electrical or other industrial hazard to the workers. A containment system must be at least as efficient as a glove bag, but be less cumbersome to use. Any fixatives applied must meet Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC) and allow for 100 gm loading of plutonium per 55-gallon drum (e.g., the presence of organics in a fixative will reduce the quantity of allowable plutonium per drum).

WBS No.: 1.4.03.3.1.02.06.03.10.42.01

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: Work must be performed in areas of high airborne alpha contamination.

Regulatory: There are no specific regulatory drivers for this need.

Environmental Safety and Health: Worker safety will be enhanced and the potential of an environmental release will be decreased by meeting this need.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$100K. LCC savings estimate is based on the assumption that a method to capture airborne alpha contamination would reduce the FY2002 and FY2003 costs by 1%. The FY2002/2003 Project cost of \$10.7M was assumed based on DOR/RL-97-44, Volume 5, Revision3, September 2000. Meeting this need may relax some of the protection requirements currently being used so that work may progress faster, thereby saving money.

Cultural/Stakeholder Concerns: Stakeholders are concerned with environmental and worker protection.

Other: None identified.

Current Baseline Technology: Personnel protection equipment such as glove bags, clothing and respirators, containment structures for protection of the environment, and a latex-based coating material used as a fixative.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kikoegle@bhi-erc.com; George Carter, BHI, (509) 373-2141, 373-6562, gicarter@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DECONTAMINATION OF TRANSURANIC DEBRIS FOR 233-S

Identification No.: RL-DD063

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: Decontamination of LLW debris (ER-05, risk = 4) and TRU debris (T3-ER, risk = 5)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 233-S

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Decontamination of transuranic (TRU) contaminated debris to LLW or to free release levels.

Need/Opportunity Category: Technology opportunity; the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: A cost-effective means of reducing the quantity of TRU waste is needed for the Hanford Site.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 12/31/2004

Problem Description: Much of the waste to be generated at 233-S is expected to be transuranic. Transuranic waste is costly to handle, store and dispose of. Also, plutonium is a major contaminant of concern at 233-S and causes issues of criticality for packaging and storage.

Benefit to the Project Baseline of Filling Need: Meeting this need would result in lesser quantities of transuranic material to be managed, packaged, stored and disposed.

Functional Performance Requirements: The technology must, as a minimum, be able to decontaminate highly contaminated metallic equipment to LLW criteria. The technology must be able to decontaminate piping and tank segments up to 20 feet long. It must also maintain a critically safe geometry for all aspects of the decontamination (e.g., for bath process this would include the bath, the liquid recycling, and all connecting piping). The contaminants of concern are plutonium, americium, and neptunium.

WBS No.: 1.4.03.3.1.02.06.03.10.42.01

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: The reduction of TRU waste quantities will reduce the packaging, storage and disposal requirements from those for TRU to those of LLW or free release material.

Regulatory: There are no specific regulatory requirements for this need.

Environmental Safety and Health: Reduction of TRU waste quantities will result in less TRU waste to contain, thereby resulting in less likelihood of a release.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$1M. LCC savings estimate is based on the assumption that after decontamination, only 1/14 of the original TRU waste is TRU and the remaining waste (13/14 of the original volume) would be sent to ERDF. Savings estimate assumes an original waste volume of 2,780 ft³ (from the Project) at a cost of \$1.1K/ft³ (project estimate of Central Waste and Waste Isolation Pilot Plant costs) versus vendor estimates that decontamination would cost \$240/ft³ and result in only 1/14 of the original TRU waste volume. The remainder was assumed to be emplaced at the Environmental Restoration Disposal Facility (ERDF) for an assumed cost of \$60/ft³. A cost-effective means of reducing TRU waste quantities will result in savings through reduction of management, storage, transportation and disposal requirements.

Cultural/Stakeholder Concerns: Reducing TRU waste quantities will result in reduced long-term liability.

Other: None identified.

Current Baseline Technology: Package, store, and dispose of the entire quantity as TRU waste.

End-User: Environmental Restoration Project

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Decommissioning Projects

Reactors Interim Safe Storage

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIELD SCREENING FOR HAZARDOUS MATERIALS FOR THE 105-D AND 105-H REACTORS

Identification No.: RL-DD033

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC01

Waste Stream: Characterization of MLLW debris (ER-01, risk = 4 & ER-02, risk = 4) and HAZ debris (ER-06, risk = 4 & ER-08, risk = 4)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: Reactors 105-D and 105-H

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|--|

Need Title: Field screening for hazardous materials for the 105-D and 105-H reactors.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: A better field and/or in situ screening method is needed for detecting, quantifying and locating hazardous materials so that regulatory limits may be verified for material to be left in place, and so that waste may be segregated as required based on waste disposal criteria. The main hazardous contaminants of concern are RCRA metals, PCBs and sodium dichromate.

Schedule Requirements:

Earliest Date Required: 10/01/2001

Latest Date Required: 9/30/2003

Problem Description: Characterization of structures and material to be left in place is required to verify regulatory limits have been met. Currently, below grade structures must be sampled to verify limits have been met. Such sampling requires sampling under the below grade structures, which is time consuming and costly.

Also, waste material must be segregated into hazardous, mixed and low level waste streams. The current method of segregation is to first create the waste through D&D, package the waste, sample the waste, send the sample to a laboratory, wait two to three weeks and then segregate the waste according to the results. This is a time consuming process and is inefficient in that not all material is tested, only the samples. Therefore, an entire drum of material may be treated as mixed or hazardous based on a few

samples. An in situ method would allow operators to identify hazardous and mixed material prior to mixing with material that is clean or only radioactively contaminated. Such a method would save costs by reducing the amount of mixed and hazardous waste, by reducing lab requirements, by reducing waste handling, and by reducing the wait time. Such a method would also reduce human error involved in sampling, record keeping, laboratory analysis, laboratory reporting, multiple waste handling, etc.

Benefit to the Project Baseline of Filling Need: Such a method would save costs by reducing the work required to verify regulatory limits have been met for material left in place, reducing the amount of mixed and hazardous waste, reducing lab requirements, reducing waste handling, and reducing the wait time.

Functional Performance Requirements: A near real-time, in situ method is needed to detect, quantify and locate RCRA metals, PCBs and sodium dichromate to regulatory criteria. Any method should be applicable to below grade concrete structures to determine if they must be remediated or to verify regulatory limits have been met for leaving in place. Analysis methods that are not in situ but that can be applied in the field may be acceptable if they provide quick turnaround (less than two days). The method would be used on construction materials and any items within or under the facilities.

WBS No.: 1.4.03.1.1.05.06.02.05.42.10 and 1.4.03.1.1.04.06.02.08.42.10

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: Characterization information is needed to verify regulatory limits have been met for material to be left in place and to properly segregate waste. Quicker methods involving less handling will result in lower cost, less error and the ability to classify material in situ.

Regulatory: Waste classification is needed to verify regulatory limits have been met, to segregate waste, and meet waste disposal requirements.

Environmental Safety & Health: Verification that material left in place meets regulatory requirements and proper segregation of waste helps to ensure environmental safety and health.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$700K. LCC savings estimate is based on the assumption that 1% of the last year's project costs for 105-F and 105-DR could have been realized and that similar savings would be realized on the other 5 reactors that will be put into interim safe storage. Project costs of \$14.4M for 105-F and \$14M at 105-DR (from the Estimate at Completion that is updated annually by Project Controls) was used. Such a method would save costs by reducing the work required to verify regulatory limits have been met for material left in place, reducing the amount of mixed and hazardous waste, reducing lab requirements, reducing waste handling, and reducing the wait time.

Cultural/Stakeholder Concerns: Stakeholders are concerned that material left in place meets regulatory limits and that waste is handled properly.

Other: None identified.

Current Baseline Technology: The current method of collecting and sending samples to laboratories results in a turnaround time of two to three weeks. Also, one must dig or drill under the below grade structures in order to get samples.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Mark Morton, BHI, (509) 373-1628, 373-5418, mrmorton@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

Contractor Facility/Project Manager: Mike Mihalic, BHI, (509) 373-1382, (509) 373-5418, mamihali@bhi-erc.com

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CHARACTERIZATION OF THE 105-H SPENT FUEL BASIN

Identification No.: RL-DD072

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-RC01

Waste Stream: Characterization of LLW debris (ER-05, risk = 4)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: 105-H

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Characterization of the 105-H spent nuclear fuel basin and contents.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Technologies are needed for the characterization, including visual imaging, of the material in the 105-H spent nuclear fuel basin (hereafter referred to as the basin). The basin is filled with soil backfill, but have equipment, sludge, and possibly other unknown materials in the bottom.

Schedule Requirements:

Earliest Date Required: 6/1/2002

Latest Date Required: 12/30/2002

Problem Description: The 105-H spent fuel basin is a reinforced concrete basin about 6,000 square feet and 22 feet deep. The basin (and pick up area) contains contaminated sludge estimated to be 6 to 8 inches deep. Graphite stringers, aluminum tubing, galvanized shipping buckets, and other miscellaneous radioactive materials are on the basin floor. The water in the basin was drained down to approximately three feet and then the basin was completely filled with soil. The concrete walls and floor of the basin are also contaminated to an unknown extent. Severe leakage from the basin into the surrounding soil probably did not occur.

Benefit to the Project Baseline of Filling Need: By characterizing the contents of the basin prior to work initiation, unexpected events (e.g., uncovering very high dose rate or fuel material) will be minimized because work and worker protection can be better planned.

Functional Performance Requirements: It is desirable that characterization be completed prior to removal of the soil backfill. Characterization includes identifying and providing visual images of material within the basin, locating material, and determining the radioactive contamination levels by location/material. Characterization is required for the soil in the basin, the material placed in the bottom of the basin, and the basin walls themselves. Determination of RCRA metals and other hazardous materials is desirable. Characterization of radioactive contamination in the soil that is in and under the basin is also desirable.

WBS No.: 1.4.03.1.1.04.06.02.08.42.10

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: In situ characterization will lead to reduced personnel exposures and better planning.

Regulatory: The Tri-Party Agreement applies to the decommissioning of 105-H

Environmental Safety and Health: By characterizing the contents of the basin prior to work initiation, unexpected events (e.g., uncovering very high dose rate or fuel material) will be minimized because work and worker protection can be better planned.

Cost Savings Potential (Mortgage Reduction): Proper planning, versus planning for worse case unknowns, will minimize cost.

Cultural/Stakeholder Concerns: Stakeholders are concerned with worker and environmental protection.

Other: None identified.

Current Baseline Technology: GammaCam™, Eberline RO-7™, LARADS™, and ISOCSTM after the top 17 feet of fill is removed

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Mark Morton, BHI, (509) 373-1628, 373-5418, mrmorton@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

ASBESTOS ABATEMENT FOR THE KE-, KW, AND N-REACTOR AREAS

Identification No.: RL-DD074

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-RC01

Waste Stream: Asbestos (ER-07, risk = 1)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: Facilities in KE-, KW-, and N-Reactor Areas

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Asbestos abatement for facilities in the KE-, KW-, and N-Reactor Areas

Need/Opportunity Category: Technology opportunity - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Technologies are needed for stripping asbestos from piping and ductwork.

Schedule Requirements:

Earliest Date Required: 10/1/2004

Latest Date Required: Unknown

Problem Description: The N-Reactor alone has miles of asbestos-coated piping that will be very costly to remediate using current technologies. Also, the large ductwork throughout the Reactor Areas is coated with asbestos.

Benefit to the Project Baseline of Filling Need: Stripping asbestos remotely/semi autonomously would increase worker safety, and, with certain methods, could reduce the overall labor and time to strip asbestos. The end result could be a cost savings and timesavings to the project.

Functional Performance Requirements: The technology must be an improvement over hands on techniques. Potential areas for improvement include: reduction of required containment and automated stripping and bagging. The technology should work on circular piping and rectangular ductwork ranging from 2 inch in diameter to 48 inch on side. It is desired that any technology would be able to negotiate hangers and seams/connectors. It is also desired that the technology be applicable to piping and ductwork with zero clearance from walls, floors or ceilings.

WBS No.: 1.4.03.1.1.08.06.01

TIP No.: TIP-0008

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: There are miles of asbestos-coated piping in the N-Reactor Area alone.

Regulatory: All regulations related to asbestos handling.

Environmental Safety and Health: An asbestos abatement technology could result in less exposure of personnel to asbestos.

Cost Savings Potential (Mortgage Reduction): There is a potential for reduced cost depending on the types of improvements over hands-on techniques.

Cultural/Stakeholder Concerns: Worker protection is a stakeholder concern.

Other: None identified.

Current Baseline Technology: Standard hands-on techniques for asbestos abatement.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Mark Morton, BHI, (509) 373-1628, 373-5418, mrmorton@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DENSE CONCRETE DEMOLITION FOR THE INTERIM SAFE STORAGE PROJECT

Identification No.: RL-DD076

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/ Hanford Site

PBS No.: RL-RC01

Waste Stream: LLW Debris (ER-05, risk = 4)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: Facilities in the Reactor Areas

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Dense concrete demolition for the Interim Safe Storage Project

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: An improved method is needed to demolish dense, reinforced, thick concrete.

Schedule Requirements:

Earliest Date Required: 10/3/2001

Latest Date Required: 9/30/2009

Problem Description: Dense, reinforced, thick concrete is very difficult and expensive to demolish and size reduce for disposal.

Benefit to the Project Baseline of Filling Need: Reduced cost (manpower, equipment repair/replacement) for demolishing dense, reinforced, thick concrete.

Functional Performance Requirements: The method must be faster and/or less costly than the baseline, and not increase the noise/dust/spread of contamination issues of the baseline methods.

WBS No.: 1.4.03.1.1

TIP No.: TIP-0010

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: Current techniques for demolishing dense concrete are expensive and very hard on equipment. Equipment failure causes both schedule delays and increased cost.

Regulatory: N/A

Environmental Safety and Health: N/A

Cost Savings Potential (Mortgage Reduction): Unknown.

Cultural/Stakeholder Concerns: N/A

Other: None identified.

Current Baseline Technology: Backhoes and excavators equipped with shears, hammers, pulverizers and standard demolition equipment are the current baseline.

End User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Mark Morton, BHI, (509) 373-1628, 373-5418, mrmorton@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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Additional Decommissioning

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

METAL DECONTAMINATION AND RECYCLING FOR THE D&D PROGRAM

Identification No.: RL-DD021

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC01

Waste Stream: Metal LLW debris (ER-05, risk = 4)

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: Hanford facilities undergoing final decontamination and decommissioning

Priority Ranking: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Metal decontamination and recycling for the D&D program.

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Metal decontamination and recycling is needed to cost-effectively reduce radioactive waste volumes and allow for recycle/reuse of metals and equipment.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 9/30/2046

Problem Description: The estimated total volume of metallic waste exceeds 150,000 m³. Current plans are to dispose of this waste at the ERDF. Disposal of contaminated materials and equipment results in loss of assets as well as the resources expended to dispose of the assets. An effective means of decontamination and verification of results is needed to avoid such losses.

Benefit to the Project Baseline of Filling Need: Reduced waste volumes will be placed in the ground, resulting in reduced long-term liability. Potential cost savings include: (1) disposal costs are avoided, and (2) the cost of obtaining an asset is reduced (e.g., the cost to make a drum from recycled material is less costly than to buy a new drum).

Functional Performance Requirements: Methods are needed that can cost-effectively decontaminate materials so that they can be released to uncontrolled areas for recycle or reuse. The requirements for the technology include:

- Decontaminate pipes and internal components to allow for release to uncontrolled areas
- Verify that the free release criteria have been met. This includes methods for inspecting equipment and piping internals and other difficult geometries
- Be cost competitive with the alternative of sending the materials to the Environmental Restoration Disposal Facility (ERDF)
- Minimize secondary waste generation and avoid any hazardous/mixed waste generation
- Easily deployed
- As a minimum, any technology should be applicable to the reuse/recycle of steel and carbon steel.

WBS No.: 1.4.03.1

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: Current methods are not cost-effective for reducing radioactive waste volumes.

Regulatory: Regulations for release to uncontrolled areas.

Environmental Safety & Health: Long-term liability (potential for a release) could be reduced with recycling and reuse of materials.

Cost Savings Potential (Mortgage Reduction): Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$10M for the DOE Complex including \$2M for the Hanford Site. LCC savings estimate is based on the assumption that metal decontamination could result in double the savings realized by lead decontamination. Potential areas of cost savings include: (1) the cost of disposal is avoided, and (2) the cost of obtaining an asset is reduced (e.g., the cost to make a drum from recycled material is less costly than to buy a new drum).

Cultural/Stakeholder Concerns: Reducing waste volumes that will be placed in the ground will result in reduced long-term liability.

Other: None identified.

Current Baseline Technology: Piping and equipment suspected of internal contamination are usually disposed of on site as radioactive waste at extremely low cost (FY 1997 costs of \$78/m³ for disposal, handling and transportation). When suspect materials are to be decontaminated, chemical treatment or surface cleaning with high-pressure water jets is applied prior to the release of these materials.

End-User: Environmental Restoration Project

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kikoegle@bhi-erc.com; Mark Morton, BHI, (509) 373-1628, 373-5418, mrmorton@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-6417, sue.garrett@pnl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

MOBILE TEMPORARY VENTILATION SYSTEM FOR THE ENVIRONMENTAL RESTORATION PROJECT

Identification Number: RL-DD073

Date: August 2001

Program: Decontamination and Decommissioning

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC01

Waste Stream: N/A

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: All facilities requiring ventilation

Priority Rating: This entry addresses the Accelerated Cleanup: Paths to Closure (ACPC) Priority:

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☒
☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: A mobile temporary ventilation system for the Environmental Restoration Project

Need/Opportunity Category: *Technology opportunity* - the project desires an alternative to the current or planned baseline technology/process (i.e., a baseline exists but can be improved).

Need Description: Before a facility can be decommissioned, it is desirable to turn off and permanently disconnect all electrical power to the facility for safety. However, if ventilation is required for containing contamination while decommissioning work is ongoing, electrical power cannot be turned off and disconnected. A portable system that can be moved from facility to facility would alleviate the need to construct temporary ventilation at each facility.

Schedule Requirements:

Earliest Date Required: 10/1/2001

Latest Date Required: 9/30/2046

Problem Description: Negative pressure must be maintained on some facilities to reduce the potential of the spread of contamination within the facilities to "clean" areas and to reduce the potential of contamination release to the environment. Maintaining the original ventilation system during D&D requires personnel to perform selective energy checks on the original electrical system so that unneeded electrical paths may be disconnected, increasing electrical risk to personnel. Constructing temporary ventilation for each facility requires manpower and time.

Benefit to the Project Baseline of Filling Need: Worker safety will be enhanced and the potential of an environmental release will be minimized by meeting this need. Meeting this need would allow workers to turnoff and disconnect all electrical power without performing energy checks, thereby reducing worker

load and cost. Meeting this need would also do away with the need to construct a temporary ventilation system for each facility, thereby reducing manpower and decreasing the schedule.

Functional Performance Requirements: The system must meet Clean Air Act requirements and allow for sampling. The system must be able to maintain negative pressure in a facility. It may use existing ductwork, when available, but should also be applicable when no closed-system ductwork is available. Exhaust units and supply air conditioning equipment are required. Two sets of functional requirements are provided below for each category of equipment:

Exhaust Air:

1. 4,000 cfm minimum at 5.0" w.g. SP with clean filters to 6,000 cfm maximum at 10.0" w.g. SP with dirty filters.
2. 6,000 cfm minimum at 5.0" w.g. SP with clean filters to 12,000 cfm maximum at 10.0" w.g. SP with dirty filters.

Supply air-handling Units:

1. Fan performance range is 3,500 cfm minimum at 5.5" w.g. to 5,500 cfm maximum at 6.5" w.g. SP with a heating coil capacity of 55 kW, 480 V, 3 phase, 60 Hz power supply, and a cooling coil capacity of 25 tons of refrigeration.
2. Fan performance range is 5,500 cfm minimum at 5.5" w.g. to 11,000 cfm maximum at 6.5" w.g. SP with a heating coil capacity of 110 kW, 480 V, 3 phase, 60 Hz power supply, and a cooling coil capacity of 45 tons of refrigeration.

WBS No.: 1.4.03.1.1

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-031

Justification for Need:

Technical: Having to selectively turnoff and disconnect electrical power increases worker safety risk.

Regulatory: Clean Air Act.

Environmental Safety and Health: Worker safety will be enhanced and the potential of an environmental release will be minimized by meeting this need.

Cost Savings Potential (Mortgage Reduction): Meeting this need would allow workers to turnoff and disconnect all electrical power without performing energy checks, thereby reducing worker load and cost.

Cultural/Stakeholder Concerns: Stakeholders are concerned with environmental and worker protection.

Other: None known.

Current Baseline Technology: Maintaining use of the original ventilation system and selectively performing energy checks, turning off and disconnecting electrical power is one baseline used by the

projects. The other baseline is to construct a temporary, job specific ventilation system at each new facility.

End User: Environmental Restoration Project

Site Technical Points of Contact:

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DEACTIVATION SCIENCE NEEDS

SCIENCE NEEDS/OPPORTUNITIES STATEMENT

PHOTON-ASSISTED DECONTAMINATION CHEMISTRY

Identification No.: RL-DD022-S

Date: October 2000

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated materials and equipment, tanks, pipes, gloveboxes, ducting, etc.

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating:

This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- ☐ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Photon-Assisted Decontamination Chemistry

Need/Opportunity Category: *Science Opportunity* – The site desires an alternative or enhancement to the current or planned baseline technology/process (e.g., a baseline approach exists but can be improved). Fundamental science information is required to improved the process or reduce uncertainty.

Need Description: A technology is required that will decontaminate both metal and concrete surfaces (with and without fixatives) without the use of liquid solvents. Laser technology has been explored in funded research from the D&D Focus Area that meets this functional need. The use of laser decontamination technology has the potential to minimize the creation of secondary waste and hazardous effluents.

Schedule Requirements:

Earliest Date Required: (01/01/01)

Latest Date Required: (09/30/07)

Problem Description: A significant effort has been made by DOE EM-50 to develop a decontamination system using laser technology to meet this functional need. The previous work used CO₂ and Nd:YAG laser systems that were commercially available. However, as these technology development programs have progressed, a lack of understanding of the fundamental laser ablation processes has been identified.

The photochemical and photomechanical mechanisms of laser ablation need to be analyzed and fundamental models developed. This includes photo-induced molecular bond dissociation and laser-induced plasma formation and shock propagation.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: N/A

Benefit to the Project Baseline of Filling Need: Benefits to be realized by the Projects may include decontamination task efficiencies/schedule reduction, waste volume/class reduction and the reduction in associated disposal costs. Dose reduction and ALARA-based improvements should also be realized. This Science Need supports the following Hanford Technology Needs: RL-DD03, RL-DD06, RL-DD021, RL-DD059, RL-DD063

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: See Need RL-DD06 for general decontamination technology performance requirements

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-04-902, Select Technologies for Duct Cleaning and Removal, April 15, 2003

End User: EM-40.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

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SCIENCE NEEDS/OPPORTUNITIES STATEMENT

EFFLUENT CAPTURE

Identification No.: RL-DD025-S

Date: October 2000

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated materials and equipment, tanks, pipes, gloveboxes, ducting, etc.

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating:

This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- ☐ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Effluent Capture

Need/Opportunity Category: *Science Opportunity*— The site desires an alternative or enhancement to the current or planned baseline technology/process (e.g., a baseline approach exists but can be improved). Fundamental science information is required to improved the process or reduce uncertainty.

Need Description: Smoke from cutting tools needs to be captured in a safe and efficient manner to maximize clarity in the cutting area and minimize secondary contamination.

An understanding is needed of the particle sizes associated with the smoke from use of alternative cutting methods (e.g., laser cutting, plasma torch, gasoline torch, etc.) on various materials. As the particle size may vary with the material being cut, various metals (e.g., stainless steel and coated and uncoated carbon steel) may need to be tested for a full understanding of the generated particles sizes.

Schedule Requirements:

Earliest Date Required: (01/01/01)

Latest Date Required: (09/30/07)

Problem Description: Different cutting tools generate smoke and particles of different sizes. The smoke and particles have been known to foul HEPA filters very quickly, resulting in the need to replace the HEPA filters. Some work-arounds have been used, such as electrostatic precipitators and mini-cyclones. A better understanding of the particle size associated with the smoke from different cutting techniques would allow for the optimal capture technology to be employed.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD

Benefit to the Project Baseline of Filling Need: Cost savings and dose reductions associated with possible improvements in workspace air quality and extended HEPA filter life.

This Science Need supports the following Hanford Technology Needs: RL-DD02, RL-DD08, RL-DD030, RL-DD048, RL-DD062

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: See general performance requirements noted in Technology Need RL-DD08 for remote cutting technologies.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-04-902, Select Technologies for Duct Cleaning and Removal, April 15, 2003

End User: EM-40.

Contractor Facility/Project Manager: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

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SCIENCE NEEDS/OPPORTUNITIES STATEMENT

CONTAMINANT BINDING SCIENCE NEED

Identification No.: RL-DD026-S

Date: October 2000

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated materials and equipment, tanks, pipes, gloveboxes, ducting, etc.

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Buildings 324 and 327

Priority Rating:

This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- _____ 1. Critical to the success of the ACPC
- _____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- X 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Contaminant Binding Science Need

Need/Opportunity Category: *Science Opportunity* – The site desires an alternative or enhancement to the current or planned baseline technology/process (e.g., a baseline approach exists but can be improved). Fundamental science information is required to improved the process or reduce uncertainty.

Need Description: Long-life, cost-effective, remotely applicable fixatives and decontaminants are needed for a variety of contaminants (Cs, Sr, Pu, U, Pb, and other RCRA metals) and surfaces (e.g., coated and uncoated concrete, cement covered with asphalt, coated and uncoated carbon steel, and stainless steel glove boxes and ductwork). The products must be easy to apply and remove. Fixatives and decontaminants are needed for underwater application as well as for dry application.

An improved understanding is needed of contamination chemistry and associated binding mechanisms for a wide variety of surface materials. Such knowledge would help to promote the development of more cost-effective decontamination and fixative products. Improved knowledge and literature on the long-term effects of radiation on commercially available fixatives would also help to ensure that proper coatings are selected for given contaminants and expected periods of performance. Better decisions would also be made concerning tradeoffs between decontamination and/or fixatives to support deactivation, long-term surveillance and maintenance, decommissioning, and demolition objectives.

Schedule Requirements:

Earliest Date Required: (01/01/01)

Latest Date Required: (09/7/07)

Problem Description: Loose, dispersible and fixed surface contamination (e.g., Cs, Sr, Pu, U, Pb and other RCRA metals) is present in high- and low-radiation areas on various surfaces (e.g., coated and uncoated concrete, coated and uncoated carbon steel, glass, plastics, rubber and stainless steel). The dispersible contamination presents an immediate worker exposure concern and a long-term environmental concern. Current fixative techniques are paint, tar, polymeric barrier systems, rustoleum, or no fixative. Some of the current fixative techniques are ineffective (no fixative and rustoleum), allow leaching of radioactive material, allow for build up of hydrogen and/or helium over time, or are costly to apply and remove.

Decontamination methods are needed that minimize worker exposures, waste generation, costs, and risks and do not create mixed waste. Current methods for decontamination are costly and time consuming, and many of them create secondary waste. Baseline decontamination technologies are scabbling and hydro-lancing for concrete; wipes, hydro lancing, ice blasting, steam, acid washes, and electropolishing for metals; and wipes and strippable coatings and gels for glove boxes.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: BD

Benefit to the Project Baseline of Filling Need: Effective use of fixatives supports ALARA practices and results in a more controlled and safer and more efficient environment for workers. Other expected benefits are noted in the paragraph above. This Science Need supports the following Hanford Technology Needs: RL-DD03, RL-DD04, RL-DD06, RL-DD07, RL-DD09, RL-DD021, RL-DD032, RL-DD059, RL-DD062, RL-DD063

Relevant PBS Milestones:

TRP-06-921	324 Deactivation Complete	September 22, 2006
TRP-07-930	327 Deactivation Complete	September 7, 2007

Functional Performance Requirements: The fixative may be used to immobilize dispersible alpha, beta, and gamma contamination. In some situations, the fixative may need to be easily removable to allow for eventual decontamination. Thin-filmed fixatives with a 20-25 year life are preferred. A two-phased fixative would be acceptable: 1) long-term fixative and 2) stripper that easily removes the long-term fixative.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: N/A

End User: EM-40.

Contractor Facility/Project Managers: Malcolm S. Wright, Director - 324 Facility Deactivation Project, Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov); William A. Hooper, Director - 327 Facility Deactivation Project, Fluor Hanford (FH), (509) 376-9717, Fax: (509) 376-5420, [William A Hooper@rl.gov](mailto:William_A_Hooper@rl.gov)

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376-9964, [Richard L Rich Hobart@rl.gov](mailto:Richard_L_Rich_Hobart@rl.gov); Suzanne M. K. Garrett, Pacific Northwest National Laboratory, (509) 375-2398, Fax (509) 375-5921, Sue.garrett@pnl.gov

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SCIENCE NEEDS/OPPORTUNITIES STATEMENT

NEUTRON DETECTION FOR SORTING REMOTE-HANDLED RADIOACTIVE WASTE INTO TRU VS. NON-TRU

Identification No.: RL-DD035-S

Date: November 2001

Program: 300 Area Facility Transition

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RC06

Waste Stream: Radioactively contaminated materials and equipment, tanks, pipes, gloveboxes, ducting, etc.

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Building 324

Priority Rating:

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

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☒	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Neutron Detection for Sorting Remote-Handled Radioactive Waste into TRU vs. Non-TRU

Need/Opportunity Category: *Science Opportunity* - The site desires an alternative or enhancement to the current or planned baseline technology/process (e.g., a baseline approach exists but can be improved). Fundamental science information is required to improved the process or reduce uncertainty.

Need Description: new class of field-applicable neutron detectors is needed to measure transuranics (TRU) in remote-handled waste with high gamma radiation. The science need is solving the problem of neutron-gamma discrimination in detector materials (scintillators, gases, or other types) so that a new class of neutron detectors may be developed for sorting transuranic-containing remote-handled LLW. The new detectors must be highly sensitive to the relatively few neutrons that are emitted from transuranic waste but insensitive to the much more numerous gamma rays that produce the high radiation associated with remote-handled waste. (Traditional gamma-ray spectrometry is not expected to be practical for TRU measurements because of interferences from the intense gamma radiation produced by other sources, such as Cs-137.)

Schedule Requirements:

Earliest Date Required: (01/01/01)

Latest Date Required: (09/30/06)

Problem Description: There is an urgent need to sort remote-handled low-level waste containing transuranic materials. Waste with high levels of cesium-137 and moderate levels of transuranic materials is collected and packaged in steel containers (grouted and ungrouted) as part of the 324 Building B-Cell Cleanout Project. The transuranic content has been established in the past by an indirect method based solely on dose rate measurements and limited sampling and analysis; such an approach is now in question. Many other buildings and waste sites within the DOE complex also have similar needs for distinguishing TRU in the presence of high gamma-ray radiation. As an example, caissons (underground tanks at Hanford into which highly contaminated items were inserted through a deviated chute) also contain TRU waste that has high gamma radiation. Items contaminated to a lesser degree are located in burial grounds that will be excavated and their waste sorted by TRU content.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD

Benefit to the Project Baseline of Filling Need: Benefits realized by the projects should include characterization task efficiencies/schedule reduction, waste volume/class reduction and the reduction in associated disposal costs. Dose reduction and ALARA-based improvements should also be realized.

Relevant PBS Milestone:

TRP-06-921	324 Deactivation Complete	September 22, 2006
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Functional Performance Requirements: A method is needed that will allow for real-time differentiation between TRU and non-TRU waste, between low-level waste and free-release waste and/or provide quantitative assessment of remaining contamination. Characterization is required for a variety of configurations including walls, ceilings, equipment, hot cells, and hot cell support equipment.

- a) Ducts/Piping - Improvements are needed for the remote, in situ characterization of contamination levels in ducts and piping. Ductwork may have obstructions and limited access. Contaminants include cesium, strontium, uranium, and transuranics. The technology would need to be adaptable to a variety of configurations. Ducts and piping constitute examples of long-length and large-size contaminated equipment at Hanford that needs to be measured for TRU content in high gamma-ray fields. Other examples include long items to be removed from underground liquid-waste storage tanks and large pieces of contaminated process equipment. Long-length and large-size items share the common problem that they will not fit into barrels or boxes where conventional TRU analysis techniques can be applied. Many of these items are contaminated only in localized spots. By screening large items for localized TRU, it should be possible to segregate the contaminated parts and greatly reduce the volume of waste that needs to be treated as TRU.
- b) Remote Radiation Mapping - Remotely deployable radiation mapping techniques are required. Methods should permit the identification of hot spots within an area containing high radiation levels.
- c) Segregation Techniques - Techniques are needed that can differentiate between contaminated and non-contaminated material and for equipment that has inaccessible surfaces. Current technology allows crushed material on the order of 1 inch or less to be segregated through the assay of the material on a conveyor belt. The improved technology should permit the real-time characterization of materials larger than crushed materials.
- d) Verification - Facility Endpoint Criteria limit the amount of contamination that can remain in the facility for long-term surveillance. Techniques are needed to provide accurate, verifiable measurement of the remaining contamination on large surfaces and equipment.

Work Breakdown Structure (WBS) No.: 1.04.10, 324/327 Buildings Stabilization/Deactivation

TIP No.: TRP-03-901, Select Technologies for Characterization and Removal of Contaminated Piping,
June 27, 2003

End-User: EM-40

Contractor Facility/Project Manager: Malcolm S. Wright, Director - 324 Facility Deactivation Project,
Fluor Hanford (FH) (509) 373-5864, Fax: (509) 373-0139, [Malcolm S \(Mal\) Wright@rl.gov](mailto:Malcolm_S_(Mal)_Wright@rl.gov).

Site Technical Points-of-Contact: Gregory T. Berlin, Fluor Hanford (FH), (509) 376-2389, Fax (509)
376-1045, [Gregory T Berlin@rl.gov](mailto:Gregory_T_Berlin@rl.gov); Richard L. Hobart, Fluor Hanford (FH), (509) 373-2316, Fax (509)
376-9964, [Richard L Rich Hobart@rl.gov](mailto:Richard_L_Rich_Hobart@rl.gov); Robin L. Hill, Fluor Hanford (FH), (509) 376-4808, Fax
(509) 376-9964, [Robin L Hill@rl.gov](mailto:Robin_L_Hill@rl.gov); Suzanne M. K. Garrett, Pacific Northwest National Laboratory,
(509) 375-2398, Fax (509) 375-5921, Sue.garrett@pnl.gov

DOE End-User/Representative Point of-Contact: David T. Evans, U.S. Department of Energy, Richland
Operations Office (DOE-RL), (509) 373-9278, Fax: (509) 372-3508, [David T Evans@rl.gov](mailto:David_T_Evans@rl.gov).

Decommissioning Science Needs

SCIENCE NEEDS/OPPORTUNITIES STATEMENT

LONG TERM MONITORING SENSORS NEED

Identification No.: RL-DD37-S

Date: November, 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW Debris (ER-05, risk = 4) and MLLW Debris (ER-02, risk = 4)

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Materials Processing Facilities

Priority Rating:

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

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☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
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Need Title: Long Term Monitoring Sensors Need

Need/Opportunity Category: Science Need

Need Description:

Long-life, cost-effective, remote recording sensors are needed for the identification and monitoring in soils and ground waters of numerous analytes that have the potential for leaking out of facilities on the Hanford site.

In order to identify and quantify the species required (Table 1), novel sensors with low detection limits and robust construction must be developed. This will include the development of new construction materials, development of new techniques for detection and quantification of the analytes of interest, and new methods for remote/centralized collection of the data obtained by the sensors. This will necessarily include looking at the fields of electronics, electrical engineering, microfluidics, and chemical physics to better understand the underlying principles of sensor design and development. The main analytes of concern for the D&D project are shown in Table 1.

TABLE 1. CONTAMINANTS OF CONCERN	
Contaminant of Concern	Required Detection Limit*
Acids	0.1
Ammonium Fluoride – NH ₄ F	0.2
Hexone	0.002
Nitrates	0.1
Kerosene, normal paraffin hydrocarbons	5
Lead	0.4
Polychlorinated Biphenyls	0.05
Phosphoric Acid	2
Dichromate	0.5
Nitrite	0.1
Sulfate	2
Tributyl Phosphate	0.5
Am-241	1
Co-60	0.1
Cs-137	0.1
Eu-152/154	0.1
Np-237	1
Pu-238, Pu-239/240	1
Sr-90	1
Th-232	1
U-234, U-235, U-238	1
Gross alpha	10
Gross beta	15
* Detection limits are for full protocol. Currently available onsite capabilities are an order of magnitude worse. Values are in mg/Kg or pCi/g.	

Schedule Requirements:

Earliest Date Required: 9/30/2003

Latest Date Required: 9/30/2025

Problem Description:

Many of the facilities are to be placed in safe storage followed by long term monitoring prior to final disposition. In order to satisfy regulators and the public, a large number of chemical and radiochemical materials (see Table 1) that may leak from the facilities need to be monitored on a real-time basis in a cost-effective manner. In addition, the materials need to be monitored at levels currently unattainable with field monitoring equipment and the monitors must be able to perform over long periods of time with little or no maintenance, since some of the monitors will be located in radiologically and chemically hazardous environments.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

Rough order of magnitude (ROM) life cycle cost (LCC) savings of \$1M. LCC savings estimate is based on the assumption that long-term monitoring technologies would reduce the total cost of the waste emplacement option by 0.1%.

Benefit to the Project Baseline of Filling Need:

The development of new sensors will drastically reduce the requirement for expensive sampling campaigns followed by laboratory analysis. It will also allow for continuous real-time measurement to catch potential leaks early, decreasing the cost of remediation, if required, as well as reducing risk to health and the cost of long-term monitoring.

✕ Cost Savings ✕ Risk Reduction ✕ Enabling Knowledge

This Science Need also supports the following Hanford Technology Needs: RL-DD052

Relevant PBS Milestone: PBS-MC-030

End-User: Environmental Restoration Contractor

Contractor Facility/Project Manager: Gary MacFarlan, BHI, (509) 373-6876, (509) 373-7606, gmmacfar@bhi-erc.com

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, [kikoegle@bhi-erc.com](mailto:kjkoegle@bhi-erc.com); Sue Garrett, PNNL, (509) 375-2398, (509) 375-5921, sue.garrett@pnl.gov

DOE End User/Representative Points of Contact: John Sands, (509) 372-2282, (509) 372-0726, John_P_Sands@rl.gov; Paul Valcich, (509) 373-9947, (509) 373-9838, Paul_J_Valcich@rl.gov

SCIENCE NEEDS/OPPORTUNITIES STATEMENT

REMOTE MONITORING FOR STRUCTURAL INTEGRITY NEED

Identification No.: RL-DD38-S

Date: November 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP01

Waste Stream: LLW Debris (ER-05, risk = 4) and MLLW Debris (ER-02, risk = 4)

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Materials Processing Facilities

Priority Rating:

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

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☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote Monitoring For Structural Integrity Need

Need/Opportunity Category: Science Need

Need Description: Cost-effective, remote recording sensors are needed for the evaluation of the integrity of structures including steel tanks, concrete foundations, walls, and roofing materials.

In order to make sensors that can assess the integrity of structures, the physics and chemistry of the

processes can be performed. In addition, sensors must be developed that can evaluate unexpected stresses to the structural members so that early warning of potential failures can be achieved. A final consideration for these sensors is that they must be able to be fitted into and on existing structures. For roofing materials, the sensors can be added during the resurfacing of the roofs when the current lifetime is exceeded (PUREX, B-Plant, and 224-B are all due for new roofs within the next 5 years). This will include the development of new construction materials, development of new techniques for detection and quantification of the analytes of interest, and new methods for remote/centralized collection of the data obtained by the sensors. This will necessarily include looking at the fields of electronics, electrical engineering, mechanical engineering, microfluidics, and chemical physics to better understand the underlying principles of sensor design and development.

Schedule Requirements:

Earliest Date Required: 9/30/2003

Latest Date Required: 9/30/2025

Problem Description:

There are numerous structures on the Hanford site which are in various stages of decontamination and decommissioning, ranging from those that have not yet been worked on to those that are in a final disposition state. Current practices for the evaluation of these structures involve the visual and physical inspection of the structure by trained inspectors. In the case of roof inspections, this requires that an inspector must walk onto the roof to look for tell tale signs of failure, and for other parts of structure requires the inspectors to enter situations with difficult access (e.g. entry into confined spaces and entry into radiation areas. In the case of roof inspections, the physical act of the inspection can cause failures and will decrease the life of the roofing materials. Some remote techniques have been used to evaluate the condition of structures, such as the use of infrared cameras to determine the presence of water between the roofing material and actual roof, but this is costly is of limited value in the overall determination of the integrity of the roof.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

This need supports multiple technology that have individual cost savings associated with them.

Benefit to the Project Baseline of Filling Need:

The development of new sensors will drastically reduce the requirement for physical inspections. This will not only prolong the life of some of the structures, but will also decrease the risks associated with physical inspections. It will also allow for continuous real-time measurement to catch potential failures early, decreasing the cost of repair, if required, as well as reducing risk to health and the cost of long-term monitoring.

✗ Cost Savings ✗ Risk Reduction ✗ Enabling Knowledge

This Science Need also supports the following Hanford Technology Needs: RL-DD052, RL-DD055, RL-DD057

Relevant PBS Milestone: PBS-MC-030

End-User: Environmental Restoration Contractor

Contractor Facility/Project Manager: Gary MacFarlan, BHI, (509) 373-6876, (509) 373-7606, gmmacfar@bhi-erc.com

Site Technical Points of Contact: Kim Koegler, BHI, (509) 372-9294, (509) 372-9654, kjkoegle@bhi-erc.com; Sue Garrett, PNNL, (509) 375-2398, (509) 375-5921, sue.garrett@pnl.gov

DOE End User/Representative Points of Contact: John Sands, (509) 372-2282, (509) 372-0726, John_P_Sands@rl.gov; Paul Valcich, (509) 373-9947, (509) 373-9838, Paul_J_Valcich@rl.gov

**CROSSWALK FOR FY 2002/FY 2001 DEACTIVATION AND
DECOMMISSIONING PROGRAMS
SCIENCE AND TECHNOLOGY NEEDS**

Old (FY01)	New (FY02)	Need Title	Changes in FY 2002 Revision	PBS No.
DECOMMISSIONING (Environmental Restoration Project)				
Surveillance/Maintenance and Transition Project				
Canyon Disposition Initiative (CDI)				
RL-DD034	RL-DD034	Remote/Robotic Technologies for CDI	Revised	RL-CP01
RL-DD038		Retrieval and Characterization of Liquids for CDI	Deleted	RL-ER05
RL-DD048	RL-DD048	Volume Reduction of Equipment for CDI	Revised	RL-CP01
RL-DD049	RL-DD049	Waste Encapsulation and Stabilization for CDI	Revised	RL-CP01
RL-DD051	RL-DD051	High Profile Surface Barrier for CDI	Revised	RL-CP01
RL-DD052	RL-DD052	Long-Term Monitoring for CDI	Revised	RL-CP01
RL-DD053	RL-DD053	Operational Modeling for CDI	Revised	RL-CP01
Additional S&M				
RL-DD055	RL-DD055	Remote Monitoring System Upgrades for the S&M Program	Updated	RL-CP01
RL-DD057	RL-DD057	Long-Lived Roof Replacement for the S&M Program	Revised	RL-CP01
RL-DD058	RL-DD058	Method to Control Deep Rooted Plants for the S&M Program	Updated	RL-CP01
RL-DD059	RL-DD059	Lead Decontamination for the S&M Program	Updated	RL-RC01
RL-DD067	RL-DD067	Method for Performing Roof Inspections for the S&M Program	Updated	RL-CP01
RL-DD068	RL-DD068	New Lubricants for the S&M Program	Updated	RL-CP01
RL-DD069		Hexone Tank Sampling Technology for the S&M Program	Deleted	RL-ER05
RL-DD070	RL-DD070	Caisson Sealing Method for the S&M Program	Revised	RL-CP01
RL-DD071	RL-DD071	Method to Preserve B Reactor Exterior Ductwork for the S&M Program	Revised	RL-RC01
	RL-DD084	Sealant for Valves Containing Nitric Acid for the S&M Program	New	RL-CP01
	RL-DD085	Non-Destructive Examination and Assaying Techniques for Legacy Waste Box Characterization for the S&M Program	New	RL-CP01
	RL-DD086	Remediation of Hexone Tanks for the S&M Program	New	RL-CP01

Old (FY01)	New (FY02)	Need Title	Changes in FY 2002 Revision	PBS No.
233-S Plutonium Concentration Facility Decommissioning Project				
RL-DD029		Critically Safe Vacuum System for 233-S	Deleted	RL-ER06
RL-DD030	RL-DD030	Cutting Plutonium Contaminated Pipe for 233-S	Revised	RL-CP01
RL-DD031	RL-DD031	Non-Intrusive Detection of Pipe Contents for 233-S	Revised	RL-CP01
RL-DD032	RL-DD032	Contamination Fixative for 233-S	Revised	RL-CP01
RL-DD060	RL-DD060	Characterization for Waste Handling, Packaging and Processing for 233-S	Revised	RL-CP01
RL-DD061		Remote/Robotic Systems for 233-S	Deleted	RL-ER06
RL-DD062	RL-DD062	Method to Capture Airborne Alpha Contamination for 233-S	Revised	RL-CP01
RL-DD063	RL-DD063	Decontamination of Transuranic Debris for 233-S	Updated	RL-CP01
Decommissioning Projects				
Reactors Interim Safe Storage				
RL-DD033	RL-DD033	Field Screening for Hazardous Materials for 105-F and 105-DR Reactors	Revised	RL-RC01
RL-DD072	RL-DD072	Characterization of the 105-H Spent Fuel Basin	Updated	RL-RC01
RL-DD074	RL-DD074	Asbestos Abatement for the KE-, KW-, and N-Reactor Areas	Updated	RL-RC01
RL-DD075		Expert System for the Interim Safe Storage Project	Deleted	RL-ER06
RL-DD076	RL-DD076	Dense Concrete Demolition for the Interim Safe Storage Project	Updated	RL-RC01
Additional Decommissioning				
RL-DD021	RL-DD021	Metal Decontamination and Recycling for the D&D Program	Updated	RL-RC01
RL-DD073	RL-DD073	Mobile Temporary Ventilation System for the Environmental Restoration Project	Revised	RL-RC01
SCIENCE NEEDS				
RL-DD022-S	RL-DD022-S	Photon-Assisted Decontamination Chemistry	Updated	
RL-DD025-S	RL-DD025-S	Effluent Capture	Updated	
RL-DD026-S	RL-DD026-S	Contaminant Binding Science Need	Updated	
RL-DD037-S	RL-DD037-S	Long Term Monitoring Sensors Need	Updated	
RL-DD038-S	RL-DD038-S	Remote Monitoring or Structural Integrity Need	Updated	

NUCLEAR MATERIALS STABILIZATION
FY 2002 SCIENCE AND TECHNOLOGY NEEDS STATEMENTS

FY 2002 NUCLEAR MATERIALS STABILIZATION TECHNOLOGY NEEDS INDEX

ID #	Need Title	PBS #
Plutonium Finishing Plant (PFP)		
RL-99-004-NM	Process Optimization – Extension of Pu Precipitation Process for Hanford's Plutonium Finishing Plant (PFP)	RL-CP03
RL-00-005-NM	Moisture Measurement on Stabilized Material for 3013 Container Storage	RL-CP03
RL-00-006-NM	Long Term Gas Generation Surveillance	RL-CP03
RL-00-010-NM	Remote Sludge Removal Methods for the Plutonium Reclamation Facility Canyon Floor	RL-CP03
RL-01-012-NM	Personal Protective Equipment for Dose Reduction During Special Nuclear Material (SNM) Handling	RL-CP03
RL-01-014-NM	Chloride Wash Process to Pretreat Feed to Thermal Stabilization	RL-CP03
RL-01-015-NM	Improved Throughput Instrumentation for NDA of SNM Items	RL-CP03
RL-01-016-NM	Ability to NDA Large Burial Boxes and Long Pipe Sections with Low Plutonium Concentrations	RL-CP03
RL-01-017-NM	More Accurate, Quicker NDA of Gloveboxes and HVAC for Plutonium Holdup	RL-CP03
RL-01-018-NM	Small Sample Calorimetry Capabilities	RL-CP03
RL-01-020-NM	Item Transfer Method to Replace Current Sealout Techniques	RL-CP03
RL-02-022-NM	Remediation Method for Tank 241-Z-361 Sludge	RL-CP03
RL-02-023-NM	Surveillance of Gas Pressurization during Transportation and Storage	RL-CP03
RL-02-024-NM	Intermediate and Long-Term Surveillance of Safeguards Functions	RL-CP03
RL-02-025-NM	Hydrogen Sensor System for Transportation and Storage Containers	RL-CP03
Spent Nuclear Fuel Project		
RL-SNF08	CSB Storage Vault Inspection	RL-RS03
RL-SNF09	Improved Multi-Canister Overpack (MCO) Gas Sampling System	RL-RS03
RL-SNF10	Multi-Canister Overpack (MCO) Interrogation Method	RL-RS03
RL-SNF14	Sludge Storage and Monitoring System	RL-RS03
RL-SNF15	SNF Drying Technology	RL-RS03
WESF		
RL-DD01	Cs/Sr Capsule Leak Detection System	RL-CP02
RL-DD041	Capsule Integrity Assessment Method for WESF	RL-CP02
Science Needs		
RL-SNF13-S	Oxidation And Hydride Formation In U Metal Snf	RL-RL03

Plutonium Finishing Plant (PFP)

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROCESS OPTIMIZATION – EXTENSION OF PLUTONIUM PRECIPITATION PROCESS FOR HANFORD’S PLUTONIUM FINISHING PLANT (PFP)

Identification No.: RL-99-004-NM

Date: November 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: TBD

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant (234-5Z)

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

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☐ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings of risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|---|

Need Title: Process Optimization – Extension of Pu Precipitation Process for Hanford’s Plutonium Finishing Plant (PFP).

Need/Opportunity Category: Technology Opportunity

Need Description: The need is to optimize and further develop a precipitation process to accept various impure plutonium nitrate solutions with plutonium concentrations less than 50 g Pu/L. These impure materials initially were precipitated using the $Mg(OH)_2$ process developed by LANL for Rocky Flats. Rocky Flats has had very good experience with the process, but has not run solutions at concentrations above 25 g Pu/L. The PFP had difficulty with excessive solids volumes and moisture retention in thermally stabilized product using the $Mg(OH)_2$ precipitation process for treating both concentrated pure solution and impure filtrate, lab and development solutions. An alternate process using oxalic acid to precipitate the plutonium had been implemented with good success, but there remains the potential for a need to optimize the process parameters as various feed streams are processed. The wide variety in input streams will require assistance from laboratory development groups to assure optimum precipitation parameters are used. The correct parameters will enhance throughput, minimize plutonium lost to the filtrate, and prevent process upsets.

Schedule Requirements:

Earliest Date Required: October, 2000

Latest Date Required: April, 2002

The optimization can be performed concurrently with ongoing processing of solutions, and can directly address process upsets encountered as well as setting parameters for several minor categories of impure

solution that will be processed at the end of the campaign. Completion within this time frame would facilitate changes to the process with minimum process disruptions..

Problem Description: When operational problems are encountered as feed streams are changed, a better understanding of the technical parameters for the precipitation process is needed to avoid additional (and possibly unnecessary) time and funding requirements to process Pu-bearing solutions.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: If significant problems are encountered during treatment of solutions with impurities, the cost impact could be on the order of \$330,000 for a single month (operational cost of the campaign is near \$4 million/year) of processing delays that push out the end date of completing stabilization activities.

Benefit to the Project Baseline of Filling Need: Reduces risk and assures meeting project milestones for solution stabilization.

Relevant PBS Milestone: TRP-01-500, Complete stabilization and packaging of plutonium solutions, 12/31/01. Milestone -DNFSB 2000-1 IP Milestone, IP Commitment Number 106.

Functional Performance Requirements: In general terms, the requirements are to develop and conduct a program that provides a better understanding of the operating range and conditions for the precipitation process and respond to evolving process conditions. The program must demonstrate the acceptable solution characteristics (Pu concentration, pH range, acid normality, etc.) for the process to successfully process the solutions.

Work Breakdown Structure (WBS) No.: 1.04.05.01.03

TIP No.: N/A

Justification For Need:

Technical: DNFSB Recommendation 2000-1 identifies the need to convert this material into a form suitable for long-term storage.

Regulatory: Tri-Party Agreement Milestone M-83-00: Complete Stabilization of Process Areas Resulting from EIS ROD [PFP (Date: TBD - under negotiation)]. DNFSB 94-1 Implementation Plan, Commitment Number 106 (Complete stabilizing and packaging plutonium solutions) which is due December 2001.

Environmental Safety & Health: Prolonged storage of plutonium solutions presents safety/exposure concerns.

Cultural/Stakeholder Concerns: Employee and public exposure to radioactive materials is a concern of Hanford stakeholders. The Hanford Advisory Board has repeatedly stated that progress in meeting TPA milestones and DNFSB recommendations is crucial, for example in their letter of June 5, 1998 to the DNFSB Chairman.

Other: N/A.

Current Baseline Technology: The oxalate precipitation process was originally developed to treat fairly pure plutonium solutions. The application to solutions with larger amounts of impurities has been

deemed to be applicable but to avoid the potential for significant dilution and/or process upsets an optimization of the baseline process is desirable.

End-User: Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email [mark w Gibson@rl.gov](mailto:mark_w_Gibson@rl.gov)

DOE End-User/Representative Point of-Contact: Suzanne E. Clarke, DOE-RL, 509-373-4931, Fax 376-0695, Suzanne E Clarke@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

MOISTURE MEASUREMENT ON STABILIZED MATERIAL FOR 3013 CONTAINER STORAGE

Identification No.: RL-NM-00-005

Date: November 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

<u>X</u>	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Moisture measurement on stabilized material for 3013 container storage.

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** A thermal stabilization cycle is required by the 3013 standard, with a product that must meet a moisture measurement criteria of less than 0.5%. Until FY2001, testing was performed with a Loss on Ignition (LOI) analysis of a sample from each furnace batch. There are several issues that complicate the use of this LOI test to meet the 3013 requirements, including inability to distinguish the loss of volatile salts from moisture loss, offsets of weight loss due to moisture by weight gain due to oxidation changes or other reactions, and representative sampling difficulties. A technology that can provide more accurate indication of moisture content, either in a sample or in the entire 3013 batch, was needed.
- **Background:** the LOI test has been used for decades as an indication of material stability before vault storage, with a fair degree of success. However, analytical methods that provide more direct measurement of moisture or hydrogenous material content are available and should be implemented to meet the 3013 standard, as the material is to be stored in welded thick walled containers where pressurization is undesirable. There are several moisture measurement methods being pursued by the DOE complex, including Supercritical Fluid Extraction and Neutron Moderation, and this technology need is documented to support the ongoing efforts in this arena.

A Supercritical Fluid Extraction system was implemented at the PFP but several issues with installation and qualification on the PFP materials have prevented full use of the analytical results. A Thermogravimetric Analysis system (TGA) has been installed and is providing results analogous to an LOI test. Improved moisture measurement technology is still desirable to provide crosschecks of TGA results and possibly more efficient sample transfer/timing.

Schedule Requirements: The technology should be available in as soon as possible to support the ongoing operations on 3013 containers in the 234-5Z building.

Earliest Date Required: Now

Latest Date Required: N/A

Problem Description: See above.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A specific cost savings is not proposed for this technology, as the full impact is difficult to judge. Avoidance of recycling thermal stabilization product unnecessarily due to misleading measurement results will be a large cost savings, as each furnace batch takes nearly three shifts to prepare and process, with a crew of at least three personnel. A significant recycle rate has been observed for impure materials, where the thermal stabilization cycles should easily be removing all moisture, but volatile salts are suspected of remaining in the product and causing high LOI results.

Benefit to the Project Baseline of Filling Need: A significant benefit can accrue if product recycle can be avoided. In addition, better quality assurance of the product being placed into 3013 containers will provide technical bases for the long-term storage of this material.

Relevant PBS Milestone: TRP-05-500 Complete stabilizing and packaging oxides > 30wt%

Functional Performance Requirements: Moisture measurement technology must be capable of detecting water in a variety of plutonium bearing materials, at a level of 0.5%, to meet the 3013 standard.

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A

Justification For Need:

Technical: Measurement of actual moisture levels rather than an indirect LOI method is highly desirable, providing better quality indication of the product and avoiding false positive readings that cause recycle of stabilized material.

Regulatory: None.

Environmental Safety & Health: Glovebox operations, if required, must conform to criticality, ALARA, and human factors requirements.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: Currently PFP uses a TGA test, however ongoing DOE complex discussions on moisture measurement techniques have not resolved whether this is the best analytical test to support DOE-STD 3013 Standard requirements. A Supercritical Fluid Extraction system is still available at the PFP should technical questions about its ability to provide accurate analyses of impure material be resolved.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_Gibson@rl.gov

DOE End-User/Representative Point-of-Contact: Rudy S. Ollero, DOE-RL Material Disposition Division (509) 376-0063, Fax (509) 376-0695, [Rodolfo S Rudy Ollero@rl.gov](mailto:Rodolfo_S_Rudy_Ollero@rl.gov)

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG TERM GAS GENERATION SURVEILLANCE

Identification No.: RL-NM-00-006

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Long term gas generation surveillance.

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** Thermally stabilized plutonium bearing materials are to be stored in 3013 containers for long periods of time awaiting final disposition by the Materials Disposition program. During storage, the DOE-STD 3013 standard requires that the containers be monitored for adverse conditions. A specific requirement is that the pressurization of the inner container be monitored. Current plans are to obtain baseline digital radiography of the container lid deflection to satisfy 3013 Standard requirements, and then use a magnetically coupled pressure gage and a radio frequency transmittal system to monitor for pressure changes.
- **Background:** The monitoring of DOE-STD 3013 containers for pressure buildup is important to assure safety of the storage facility, and to ascertain the container behavior when opened at the Material Disposition program processing facility. While a system to monitor the containers via digital radiography has been developed, an alternative that requires less handling and more frequent data is desirable. The magnetically coupled pressure gage/RF transmitter system provides a significant portion of the desired attributes, but there is a potential to obtain other data from internal sensors and transmit it to monitoring equipment. Possible parameters of interest are gas composition, corrosive atmosphere behavior, and radiation spectrums.

- Improved pressure measurement technology will be used at the PFP and potentially at other DOE Sites, and other improvements in surveillance of container characteristics would also be likely to have wide spread applicability.

Schedule Requirements: The technology should be available as soon as possible to support the ongoing operations on 3013 containers in the 234-5Z building and subsequent vault storage. The installation of surveillance instrumentation into the 3013 containers on either a sample basis (representing various populations) or in each container would be decided based on cost and availability of the technology.

Earliest Date Required: Now

Latest Date Required: Completion of 3013 container welding occurs in FY 2004.

Problem Description: See above.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Cost savings are difficult to project, as the long term surveillance requirements for the DOE-STD 3013 containers have not yet been fully defined. However, if the technology provided enough information on a real time basis to substitute or decrease the frequency of destructive analysis currently envisioned, a large cost savings could be achieved, on the order of \$0.5 million dollars per year for at least 10 years.

Benefit to the Project Baseline of Filling Need: Reduced handling of stored containers for surveillance purposes could result in less dose to operators. A technology that provides remote sensing capability might also be useful for other remote information monitoring that could contribute to safeguards and security functions.

Relevant PBS Milestone: TRP-05-500 Complete stabilizing and packaging oxides > 30wt%

Functional Performance Requirements: Pressurization of the inner container head space of more than about 10 psi, up to pressures above 600 psi, must be measured and reported. The long-term performance of the container system is also of interest, in terms of corrosive behavior and internal system conditions during storage and shipping. Any technology proposed must be compatible with vault storage configurations and long-term storage radiation doses. The technology must consider the 3013 standard requirements for little or no organic allowed in the inner container, and other qualifications that might be required if the container design was affected.

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A

Justification For Need:

Technical: The ability to measure the container pressure and provide for monitoring and surveillance during long-term storage is required by the 3013 standard.

Regulatory: None.

Environmental Safety & Health: Dose reduction incurred for destructive or intrusive surveillances could be avoided.

Cultural/Stakeholder Concerns: None

Other: N/A

Current Baseline Technology: N/A

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE SLUDGE REMOVAL METHODS FOR THE PLUTONIUM RECLAMATION FACILITY CANYON FLOOR

Identification No.: RL-NM-00-010

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote Sludge Removal Methods for the Plutonium Reclamation Facility Canyon Floor

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** A method to remotely remove sludge from the PRF Canyon floor is needed, since manned entry is not permitted. Past practice for canyon floor cleanup used large quantities of nitric acid to dissolve sludges, with the solution being processed through the PRF solvent extraction system and the plutonium eventually converted to metal in the RMC line. Those processes are no longer viable. An alternative technology is needed.
- **Background:** The PRF canyon floor is lined with stainless steel, with horizontal separators to form cells. About 18kg of plutonium is estimated to be in the sludge material on the floor. This material must be removed and dispositioned to allow further PRF terminal cleanout to proceed.

Schedule Requirements: The technology should be available by October 2005 to allow the material removed to be processed through the stabilization and packaging processes immediately after vault materials are completed. Earlier removal would need to be coordinated with a window of availability for thermal processing, which may occur if the proposed "hot box" concept quickens the pace of the 234-5Z furnaces.

Earliest Date Required: October 2003

Latest Date Required: FY 2005

Problem Description: See description above.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A specific cost savings is not determined for this technology need, as a baseline for comparison is not defined.

Benefit to the Project Baseline of Filling Need: The sludge on the PRF canyon floor must be removed to proceed through the terminal cleanout schedule on the project baseline.

Relevant PBS Milestone: TRP-12-500 236-Z Cleanout Complete

Functional Performance Requirements: Cleanout levels are not yet defined, as the endpoints for the facility are not definite. However, the end goal is a slab on grade configuration, which would imply that the sludge removal would need to leave fairly low plutonium amounts, so that decontamination efforts could effectively proceed. Any removal technology should produce minimal waste and preferably no liquid waste, and provide the sludge in a configuration that could be easily handled and transferred to stabilization processes.

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A

Justification For Need:

Technical: Remote removal technology is required since manned access is prohibited. The sludge must be removed since the material is likely above 30 wt% plutonium concentration and thus will be required by the 3013 standard to be dispositioned through a stabilization and packaging process. The material must also be removed to a level that will allow effective decontamination and decommissioning efforts to commence.

Regulatory: None.

Environmental Safety & Health: None.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: None.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. 509-373-6622

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PERSONAL PROTECTIVE EQUIPMENT FOR DOSE REDUCTION DURING SPECIAL NUCLEAR MATERIAL (SNM) HANDLING

Identification No.: RL-01-012-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant (PFP)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

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☒	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Personal Protective Equipment for Dose Reduction during Special Nuclear Material (SNM) Handling.

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** During the stabilization process activities at the PFP, SNM is handled in storage containers while being transferred to/from vaults and NDA instruments, and within gloveboxes in process equipment and vessels. The dose incurred by operations staff is significant, and can result in constraints on schedule as yearly or other periodic dose limits are approached.
- **Background:** The baseline for dose control is the ALARA approach, using current personnel protective equipment (PPE) such as leaded gloves and vests, and incorporating process and storage equipment shielding. While this approach is well documented as resulting in dose reduction, there is room for improvement and innovation in the way PPE is used. Some of the PPE used for dose reduction is cumbersome, difficult to use, and reduces dexterity, as well as often being quite heavy. Light-weight, easy to wear and use PPE is sought to improve productivity and user comfort, as well as potentially providing additional dose reduction.
- **Improved PPE** would be applicable to many operations at the PFP and potentially at other facilities on the Hanford Site and other DOE Sites as well as military and commercial applications.

Schedule Requirements: A specific need date is not defined. Most dose to PFP operations personnel will be incurred through the 2000-2005 period.

Earliest Date Required: 10/2000

Latest Date Required: N/A

Problem Description: During handling of SNM materials at the PFP, radiation dose, primarily gamma and neutron, is incurred during transfers to and from storage, while performing NDA measurements, and in operating process equipment and moving containers inside gloveboxes. Much of the handling is done manually due to the design of the facility and systems, and the flexible operational sequences, and automation to remove the operator handling is impractical. Specialized PPE is used where possible to minimize radiation dose, including leaded gloves in gloveboxes and leaded vests for use while handling SNM items. However, there are limitations in the effectiveness of this PPE, in terms of weight and comfort in use. The potential for lighter, more user friendly PPE that can result in dose reduction needs to be pursued.

Material science progress has been rapid through the past several decades, and it is likely that composite materials that can perform better in both dose reduction and comfort in the user environment exist. These materials need to be identified and integrated into PPE that can be delivered to the facilities for a reasonable cost.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: A specific cost savings is not proposed for this technology, as the full impact is difficult to judge, and cost of innovative PPE is not known. However, the impact of a significant improvement in dose reduction could potentially be very large if it helps avoid schedule delays due to running up against the yearly dose limits. The cost of a single month of additional plant operations is on the order of several million dollars, and the only alternative if the yearly dose limits are limiting may be increasing the operational crews, with the attendant additional costs for training and inefficiencies in using the added manpower in specific processes.

Benefit to the Project Baseline of Filling Need: A significant benefit can accrue if significant dose reduction is achieved. Currently, one of the constraints on the project schedule is the number of operational staff that approach the yearly dose limit before the end of the year, and prevent full utilization of personnel to continue process operations. This can lengthen schedules or require hiring and training of more staff at considerable expense.

Relevant PBS Milestone: TRP-14-401, Complete PFP Deactivation, 9/30/16

Functional Performance Requirements: The improved PPE needs to be light weight and flexible to assure user comfort. Breathable fabrics or components contribute to the ability to wear the PPE for extended periods and in high heat conditions. Dose reduction gains can be measured by comparing the new materials to those in current use, and by using the ALARA analyses that have been completed for most of the PFP processes.

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A

Justification For Need:

Technical: Dose reduction is a primary goal of the mandated ALARA policy, and also provides incentive due to more efficient use of personnel and potential for both cost savings and schedule gains.

Regulatory: Federal law limits worker exposure to 5 Rem per year, and the DOE Orders and contractors administrative requirements further reduce the allowable exposure levels.

Environmental Safety & Health: Depending on the type of PPE and application, it may need to meet standards for clothing flammability, eye protection, and hand protection. Waste stream regulations for eventual disposal must be considered.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: N/A

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CHLORIDE WASH PROCESS TO PRETREAT FEED TO THERMAL STABILIZATION

Identification No.: RL-01-014-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Chloride Wash Process to Pretreat Feed to Thermal Stabilization

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** Substantial portions of the impure oxides that are to be thermally stabilized have chloride compounds as a significant impurity. These chloride compounds need to be removed or rendered non volatile at the high temperatures that will be encountered during thermal stabilization.
- **Background:** Recent laboratory tests have indicated that the chloride containing impure oxide material result in widespread and immediate furnace failure, and plugging/corrosion in the offgas lines. Other processing problems include the formation of "clinkers" or solid bricks in the furnace boat after the high temperature stabilization cycle. This type of material cannot be easily removed from the boat and is not amenable to sampling techniques to verify the moisture removal.

In addition, since about 1/2 to 1/3 of the chloride is expected to remain in the stabilized product, the resulting 3013 containers will be of concern for corrosion failure and the subject of increased surveillance efforts during storage. Past processing of other materials with halide salts has shown the salt volatility can cause problems in meeting the LOI requirements for product from the Thermal Stabilization process.

Rocky Flats Environmental Technology Site has similar material and is concerned about these problems as well, since they plan on a comparable disposition path.

Schedule Requirements: This technology is needed within the next year for application to the thermal stabilization process. The bulk of the oxides are scheduled for processing between February 2002 and August 2003.

Earliest Date Required: 09/2000

Latest Date Required: FY 2002

Problem Description: A significant number of stored impure oxide SNM items at the PFP are scrap originated from offsite processes that employed chloride salts in one form or another. This resulted in plutonium contaminated scrap items that contain chloride compounds as a major impurity. These chloride compounds have been shown to cause significant processing problems, including equipment failures, the formation of difficult to handle solid chunks during thermal stabilization, and adversely affect quality determination using the Loss on Ignition method (note the newly installed Supercritical Fluid Extraction instrumentation may avoid similar problems).

Chlorides are also a significant threat to process equipment from a corrosion standpoint. Volatile gases can have detrimental effects on offgas lines and filters, as well as the muffle furnaces used in the thermal stabilization process. The Fissile Materials Disposition program, which will receive the final stabilized product, with a washing process, but a better solution would be to remove the impurity from the material that will be placed into the standard 3013 containers.

The presence of chloride in the stabilized product will require additional surveillance to protect against the failure of containers in storage. This is the principal element of concern in development of the integrated surveillance program by the Los Alamos National Laboratory Materials Identification and Surveillance team.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: At present there is no baseline technology for chloride washing to compare for cost savings. If chloride removal cannot be accomplished, there could be large costs associated with excessive rework of thermal stabilization product, difficulties handling the solidified furnace charges, and questions on the adequacy of the sampling performed for 3013 container product. Costs incurred due to these issues could easily run into the millions of dollars (\$5 million ROM) as both operational and technical resources would be required for a period of some months to resolve them.

Benefit to the Project Baseline of Filling Need: The thermal processing of the chloride bearing impure oxides at temperatures required by the DOE-STD-3013-99 may not be possible without a solution to allow for chloride removal. The concerns with corrosion of equipment and piping, and difficulties in handling solid chunks of product material in the furnace boats, do not appear to be acceptable for a working process. This issue is seen as a critical technology need to allow the stabilization activity to be completed.

Relevant PBS Milestone: TRP-05-500, Complete stabilization and packaging of oxides >30wt%, 5/31/04

Functional Performance Requirements: The chloride removal method must be capable of removing up to 20wt% of chloride salts, with a small residual left in the original material. The separated chloride bearing waste fraction should not contain significant amounts of plutonium, and should be suitable for solidification, absorption or other straightforward method leading to a waste disposal path. Other requirements include:

Glovebox scale operation
Capable of washing 1000 kg of feed in 200 days
Ease of installation into an existing glovebox
Batch or semi-continuous operation

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A

Justification For Need:

Technical: Removal of chloride compounds from these SNM items is needed to allow the thermal stabilization process to be successful.

Regulatory: The 3013 standard requires that stabilized product processed at greater than 950C (above the melting point of the chloride salts) be sampled and meet a specific moisture content limit.

Environmental Safety & Health: Supports ALARA goals and waste minimization efforts, increased equipment reliability, less maintenance and reduced surveillance.

Cultural/Stakeholder Concerns: Wet processing activities have negative connotations and must be technically justified.

Other: N/A

Current Baseline Technology: Stabilization of the material without removing the chloride impurities, until a LOI sample (or when available Supercritical Fluid Extraction) passes the maximum moisture requirement, and equipment and furnace repair and replacement as needed.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509)-373-6622

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED THROUGHPUT INSTRUMENTATION FOR NDA OF SNM ITEMS

Identification No.: RL-01-015-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved Throughput Instrumentation for Non Destructive Analysis (NDA) of SNM Items

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** During the stabilization and disposal campaigns for the SNM at the PFP, thousands of items will be transferred to and from storage and processing. Most of the transfers are accompanied by an NDA process to analyze the amounts of transuranics in the item for safeguards and accountability purposes. These NDA analyses are also required on periodic bases to support inventory update requirements. The counting processes are time consuming and in some cases are projected to become bottlenecks in the overall material handling time cycles.

An improved NDA technology is desired to improve the throughput and support the aggressive processing and vault modification schedules to meet 2000-1 milestones. The new technology must also deal with uranium in mixed oxides and chemical impurities (low Z elements) that have traditionally impacted accuracy in measurement.

- **Background:** The activities at the PFP over the next few years are focused on stabilization and disposition of the thousands of SNM items stored at the facility.
- Any technologies that improve throughput of NDA for SNM items can be used not only during the stabilization and disposition tasks over the next 5 years, but also in future waste handling during decontamination and decommissioning at the PFP. In addition, these technologies would also have broad applications at other DOE Sites.

Schedule Requirements: This technology is needed as soon as possible to attain the maximum benefit, but can contribute to cost savings and potential schedule acceleration anytime before FY 2005 for stabilization, and after that date for storage and shipping activities.

Earliest Date Required: 09/2000

Latest Date Required: FY 2005 or beyond

Problem Description: Current NDA counting of SNM items to determine the transuranic contents is time consuming, and potentially a bottleneck in the overall material processing time cycles.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Assuming a current time cycle of approximately 1 shift per item, a technology that provides a 50% time savings, and 5,000 NDA cycles, a rough order of magnitude cost savings of \$1.4 million can be projected. Acceleration in the overall PFP stabilization schedule or in future shipping schedules due to improved NDA throughput could also provide substantial cost savings.

Benefit to the Project Baseline of Filling Need: An improvement in the NDA throughput would provide increased confidence in the ability to meet baseline milestones.

Relevant PBS Milestone: TRP-05-500, Complete stabilization and packaging oxides >30wt% plutonium, 5/31/04

Functional Performance Requirements: Technology to provide NDA measurements of transuranics must meet facility requirements for accuracy and precision, and be qualified through a intersite standards exchange program. The equipment must be sized to fit effectively within the current NDA laboratory footprint.

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A.

Justification For Need:

Technical: Improved throughput would avoid the potential for a bottleneck in the PFP stabilization project time cycles at a required, basic step in the overall SNM handling process.

Regulatory: There are likely no regulatory affects on this activity.

Environmental Safety & Health: Any equipment should consider ALARA goals, and improved throughput should contribute to dose avoidance due to less time for material to be present.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: The current method consists of separate calorimetry and gamma scan cycles on each item to determine heat output, isotopic content, and back calculate transuranic mass contents. Uranium content in mixed oxides may also be determined by neutron coincidence counting.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_Gibson@rl.gov

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

ABILITY TO NDA LARGE BURIAL BOXES AND LONG PIPE SECTIONS WITH LOW PLUTONIUM CONCENTRATIONS

Identification No.: RL-01-016-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: TRU Solid Waste/Low Level Solid Waste

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Ability to NDA Large Burial Boxes and Long Pipe Sections with Low Plutonium Concentrations

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** Large burial boxes containing low level and TRU waste are produced during the stabilization and disposal activities at the PFP. Terminal cleanout and D&D activities will produce pipe and ducting sections that must be disposed of. Accurate accountability for the transuranic contents in the burial boxes and pipe sections is difficult and can force conservative estimates to be used, resulting in inefficient and expensive use of the available burial box volume. Segregation of low level and TRU wastes is also a major issue, as the cost of disposal differs by almost an order of magnitude.
- **Background:** The activities at the PFP over the next few years are focused on stabilization and disposition, followed by a number of years of D&D activity to take the facility to a “slab on grade” status. Large amounts of low level and TRU waste containers will be produced during these activities. Any technologies that improve accountability and segregation of low level and TRU wastes can be used not only during the stabilization and disposal tasks over the next 5 years, but also in future waste handling during decontamination and decommissioning at the PFP. In addition, these technologies would also have broad applications in the waste management programs at other DOE Sites.

Schedule Requirements: This technology is needed as soon as possible to attain the maximum benefit, but can contribute to cost savings and potential schedule acceleration anytime before FY 2010.

Earliest Date Required: 09/2000

Latest Date Required: FY 2005 or beyond

Problem Description: Current NDA counting of large burial boxes and long pipe sections to determine the transuranic contents is difficult and not accurate enough to provide good segregation between low level and TRU wastes.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Assuming that there are approximately 10 burial boxes per year produced during stabilization tasks for 5 years, and 30 per year for 5 years during terminal cleanout and D&D, and that piping and ductwork demolition add an equivalent 30 boxes during D&D, there are 350 boxes to dispose. If approximately half could be determined to be low level waste rather than TRU, and the savings estimated to be about \$15,000 per box, the total cost avoidance is \$2.6 million at a rough order of magnitude.

Benefit to the Project Baseline of Filling Need: The disposition of significant amounts of waste in large burial boxes will be required to achieve the facility mission of terminal cleanout and D&D to a slab on grade status. Effective partitioning of the waste into low level and TRU portions will result in significant cost savings, and provide better safeguards accountability of TRU disposition. Also, current TRU burial box shipments are done primarily based on conservative estimates and calculated total plutonium content; more accurate values are desired by the Central Waste Complex for validation of TRU contents.

Relevant PBS Milestone: TRP-14-401, Complete PFP Deactivation, 9/30/16.

Functional Performance Requirements: Technology to provide NDA measurements of transuranic waste in large burial boxes or pipe sections must meet requirements for accuracy and precision that can determine whether the disposal limits for low level waste versus TRU waste are met. The method must be effective for a variety of waste packages, including the currently used TRU burial box.

Work Breakdown Structure (WBS) No.: 1.04.05.01.15

TIP No.: N/A

Justification For Need:

Technical: There is no current accurate method to segregate large burial boxes between low level and TRU waste categories.

Regulatory: National standards for TRU versus low level waste contents (DOE O 435.1).

Environmental Safety & Health: Accurate accountability assures that disposal of the wastes is appropriate for the hazards associated with the transuranic contents.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: The current method consists tracking material placed into containers for the burial boxes, with conservative estimates in most cases of plutonium contents, and a calculated value

for total transuranic mass content. The items placed into burial boxes, generally, have been counted using portable NDA equipment, but the accuracy is low and again conservative values are assigned to assure that criticality and disposal requirements are met. Pipe sections are counted, also, with the same portable NDA measurement equipment.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. 509-373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_Gibson@rl.gov

DOE End-User/Representative Point-of-Contact: A. K. Wright, DOE-RL Material Disposition Division (509) 373-7303, Fax (509) 376-0695, allison_k_wright@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

MORE ACCURATE, QUICKER NDA OF GLOVEBOXES AND HVAC FOR PLUTONIUM HOLDUP

Identification No.: RL-01-017-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: TRU Solid Waste

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

☐
☐
☒ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|--|

Need Title: More Accurate, Quicker NDA of Gloveboxes and HVAC for Plutonium Holdup

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** The NDA of gloveboxes and HVAC for plutonium holdup is needed for inventory control and accountability, as well as planning for D&D activities.
- **Background:** The activities at the PFP over the next few years are focused on stabilization and disposal, followed by a number of years of D&D activity to take the facility to a “slab on grade” status. Gloveboxes and HVAC will be disposed of in some format, either as-is or after size reduction. The plutonium holdup is a key datum in the disposition activities, for criticality control safety and accountability.

Schedule Requirements: This technology is needed as soon as possible to attain the maximum benefit, but can contribute to cost savings and potential schedule acceleration anytime before FY 2010.

Earliest Date Required: 09/2000

Latest Date Required: FY 2005 or beyond

Problem Description: Current NDA counting of gloveboxes and HVAC is time consuming and not very accurate. Complex assumptions and calculations can be required to accommodate the background and other sources in the vicinity of the desired counting object.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The cost savings for this technology would primarily be associated with time savings in counting and calculation, and with better planning and perhaps simpler disposition paths for the gloveboxes and HVAC sections. A specific cost savings is difficult to quantify, but a ROM estimate would be between \$1 and \$10 million, similar to that predicted for better NDA of large burial boxes.

Benefit to the Project Baseline of Filling Need: The disposition of gloveboxes and HVAC sections is required to fulfill the project mission. Quicker and more accurate NDA would result in better assurance of meeting project schedules, with the potential for acceleration of milestones and cost avoidance by less time consuming NDA cycles.

Relevant PBS Milestone: TRP-14-401, Complete PFP Deactivation, 9/30/16

Functional Performance Requirements: Technology to provide NDA measurements of transuranic waste in gloveboxes or HVAC sections must meet standards for accuracy and precision to support criticality safety and accountability criteria. It would also be desirable to determine whether the disposal limits for low level waste versus TRU waste are met in some cases. The method must be effective for a variety of gloveboxes and for HVAC sections, in the presence of potentially interfering sources.

Work Breakdown Structure (WBS) No.: 1.04.05.01.15

TIP No.: N/A

Justification For Need:

Technical: An improved NDA method for gloveboxes and HVAC sections would provide the project with better assurance that D&D goals could be attained, and potentially save both money and time.

Regulatory: None.

Environmental Safety & Health: Accurate accountability assures that criticality requirements are met, and that disposal of the wastes is appropriate for the hazards associated with the transuranic contents.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: Portable NDA equipment based on neutron counting techniques are used to determine the amount of plutonium holdup in gloveboxes and HVAC sections.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_gibson@rl.gov

DOE End-User/Representative Point-of-Contact: A. K. Wright, DOE-RL Material Disposition Division (509) 373-7303, Fax (509) 376-0695, allison_k_wright@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SMALL SAMPLE CALORIMETRY CAPABILITIES

Identification No.: RL-01-018-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Small Sample Calorimetry Capabilities

Need/Opportunity Category: Technology Opportunity

Need Description: A small sample calorimeter would provide a more accurate and potentially quicker method of determining plutonium content. Typical samples are in the range of 10 to 30 grams and provide an efficient means of attaining characterization data on feed and stabilized SNM items. The use of calorimetry has advantages in handling, accuracy and elimination of waste streams associated with other analytical methods. The primary use would be to support stabilization processing and subsequent terminal cleanout activities.

Schedule Requirements: This technology is needed as soon as possible to attain the maximum benefit, but can contribute to cost savings and potential schedule acceleration anytime before FY 2010.

Earliest Date Required: 09/2000

Latest Date Required: FY 2005 or beyond

Problem Description: Current analysis for the plutonium content of small samples is done primarily through destructive analysis techniques, though a fraction are measured by NDA counting. The destructive method generates volumes of waste that require disposal. In addition the method has proved to be subject to interferences for several of the materials being processed in the PFP stabilization efforts. A small sample calorimeter would provide a more accurate and potentially quicker method of determining plutonium content.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The cost savings for this technology would primarily be associated with time savings in counting, and avoidance of wet chemistry dose and associated waste costs. A specific cost savings is difficult to quantify, but a ROM estimate would be between \$0.5 and \$1.5 million.

Benefit to the Project Baseline of Filling Need: Quicker, more accurate determination of plutonium content of solid samples. Ability to analyze materials which interfere with current analysis method.

Relevant PBS Milestone: TRP-14-401, Complete PFP Deactivation, 9/30/16

Functional Performance Requirements: Technology must be sufficient to determine plutonium contents of 1% to 99% in small (10g) samples, accounting for the effects of impurities and interferences.

Work Breakdown Structure (WBS) No.: 1.04.05.01.15

TIP No.: N/A

Justification For Need:

Technical: A small sample calorimeter provides an alternative method for plutonium characterization of solids without wet chemistry or less accurate counting methods being employed.

Regulatory: None.

Environmental Safety & Health: None.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: Wet chemistry to separate and quantify the plutonium content, or solution counting with NDA equipment.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email [mark w Gibson@rl.gov](mailto:mark_w_Gibson@rl.gov)

DOE End-User/Representative Point-of-Contact: A. K. Wright, DOE-RL Material Disposition Division (509) 373-7303, Fax (509) 376-0695, [allison k wright@rl.gov](mailto:allison_k_wright@rl.gov)

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

ITEM TRANSFER METHOD TO REPLACE CURRENT SEALOUT TECHNIQUES

Identification No.: RL-01-020-NM

Date: September 2000

Program: Nuclear Materials Stabilization

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: N/A

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

☐
☐
☒ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|--|

Need Title: Item Transfer Method to Replace Current Sealout Techniques

Need/Opportunity Category: Technology Opportunity

Need Description:

- **Description:** The PFP stabilization and D&D activities in gloveboxes and other contaminated environments result in a large number of sealout tasks, to remove waste, samples, product, or other materials from the contamination zone into a bag that is clean on the outside. These sealout activities are inherently risky, in that contamination can be incurred from errors in the process or material defects in the plastic bags used. Contamination control practices in place to manage this risk result in inefficient operations in many instances due to common airspaces and competing activities.
- **Background:** The sealout method has been in use for decades, and in general provides a safe and effective transfer technique to remove material from a contaminated to an uncontaminated environment. However, the method requires significant operator attention and skill, at a low frequency results in contamination events. Recent development of a glovebox panel change containment device showed that for specialized cases, a technology to effect transfers with less risk and better control could be implemented. Similar development for the more frequent sealout type tasks is highly desirable.
- **Technology to transfer materials from gloveboxes without using plastic bags and sealout techniques** could have wide applicability at other Hanford Site D&D projects and throughout the DOE complex.

Schedule Requirements: This technology is needed as soon as possible to maximize benefits.

Earliest Date Required: 10/2000

Latest Date Required: 09/2014 (end of D&D activities)

Problem Description: The PFP stabilization and D&D activities in gloveboxes and other contaminated environments result in a large number of sealout tasks, to remove waste, samples, product, or other materials from the contamination zone into a bag that is clean on the outside. These sealout activities are inherently risky, in that contamination can be incurred from errors in the process or material defects in the plastic bags used.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Assuming that a technology to effectively transfer material from a glovebox would be less complex than the current sealout technology, which uses at least 3 personnel and requires an airspace analysis before the area can be released for normal use, a 50% operational cost reduction could be forecast. A conservative figure for sealouts would be on the order of 2 per day, for the next 10 years at 220 working days/yr, and a cost of \$500 per sealout, resulting in a projected cost savings of \$1.1 million. This would be partially offset by any capital cost of the technology used.

Benefit to the Project Baseline of Filling Need: Resolution of potential hazard during sealout, avoiding contamination events that adversely affect schedule, cost savings due to simpler operation with fewer personnel.

Relevant PBS Milestones:

TRP-05-500, Complete stabilizing and packaging of oxides, 5/31/04

TRP-14-401, Complete PFP deactivation, 9/30/16

Functional Performance Requirements: The technology must provide a simpler means to move material in an uncontaminated environment with free surface contamination release limits meeting the Hanford RadCon manual. It should be easily fitted to existing gloveboxes without extensive modifications.

Work Breakdown Structure (WBS) No.: 1.04.05.01.13

TIP No.: N/A.

Justification For Need:

Technical: The current method for transfer of contaminated material into an uncontaminated environment has inherent risks that should be minimized, and there are potential cost savings associated with a simpler method.

Regulatory: None.

Environmental Safety & Health: None.

Cultural/Stakeholder Concerns: None.

Other: N/A

Current Baseline Technology: None.

End-User: Fluor Hanford, Inc., Nuclear Materials Stabilization Project

Contractor Facility/Project Manager: George W. Jackson, Director, Nuclear Materials Stabilization Project, Fluor Hanford, Inc. (509) 373-6622

Site Technical Points-of-Contact: M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_Gibson@rl.gov

DOE End-User/Representative Point-of-Contact: M. R. Hahn DOE-RL Material Disposition Division (509) 373-9872, Fax (509) 376-0695, Mark_R_Hahn@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMEDIAION METHOD FOR TANK 241-Z-361 SLUDGE

Identification No.: RL-02-22-NM

Date: October 2001

Program: Plutonium Finishing Plant

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP03

Waste Stream: Tank 241-Z-361 Sludge

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Plutonium Finishing Plant (PFP)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority.

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Remediation Method for Tank 241-Z-361 Sludge.

Need/Opportunity Category: *Technology Need* -- There is no currently identified technology that has been demonstrated to be capable of solving the site's problem in a cost-effective manner.

Need Description: Tank Z-361 is located at the Plutonium Finishing Plant (PFP) and is part of the PFP cleanout efforts. This underground settling tank contains legacy sludge resulting from waste discharges from past missions at PFP. There are approximately 67 cubic meters (18,000 gallons) of settled sludge, including about 25 kilograms of plutonium 239 (30 kg total fissile isotopes) currently in the tank. The tank also contains polychlorinated biphenyls (PCBs) of regulatory significance (>50 ppm on two of the samples). The tank is over 50 years old, and video inspection indicates its interior is somewhat degraded. As legacy waste, the remediation of the tank and sludge falls under regulation by the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA). The project is faced with continued safe storage of the sludge in Tank Z-361 and, if required, elimination or reduction to acceptable levels of the threat of release of sludge from the tank. The current situation remains an issue of concern to the regulators and to the public; therefore, there is a need to demonstrate selected remediation technologies and to determine the most appropriate remediation method for this sludge. The technology used for Z-361 may also be directly applicable to several other similar tanks at the Hanford site.

Schedule Requirements:

Earliest Date Required: 10/01/01

Latest Date Required: 6/30/02

The need dates above are based on coordination with the planned Engineering Evaluation/Cost Analysis (EE/CA) for Tank Z-361, as required under CERCLA. The EE/CA for Z-361 is currently planned for

fiscal year 2002 and a baseline change request is being prepared to formalize this plan. The EE/CA is equivalent to the conceptual design phase under conventional project nomenclature, so this is the appropriate time for technology demonstrations necessary to confirm the project path forward and generate cost estimates of acceptable accuracy.

Problem Description: Tank 241-Z-361 is an inactive, rectangular underground tank used as a settling tank to receive low-salt (caustic), liquid effluent from PFP processes from 1949 to May 1973. After 1973, the supernatant liquid was pumped from the tank, leaving about 67 cubic meters of sludge in the tank. A disposal pathway needs to be selected that best addresses the goal of alleviating the health and environmental risks of the tank and its contents.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The cost estimate in the current MYWP baseline for remediation of Z-361 was prepared in 1999, before complete characterization data were available. The baseline plan is to pump small quantities of the sludge out of the tank, mix it with grout, and pump it into small containers for criticality control. The estimate is quite conservative, as the strict controls for flammable gas hazards and criticality prevention in effect at the time were assumed, based on the information then available. Strict controls for prevention of alpha contamination are also incorporated, and a high frequency of sampling and analysis is assumed. The approach is of necessity very slow and labor-intensive. The estimated cost using this approach is \$25 million. This estimate was obtained using analogies with other Hanford work, with some bottoms-up detail used to implement the assumptions made.

More recent order of magnitude estimates have incorporated characterization data that indicate the absence of flammable gas in the tank headspace and the extremely low likelihood of criticality. They have also allowed for the use of a commercial remediation contractor with applicable specialized experience and equipment. One very promising remediation technology is in situ vitrification (ISV), and some estimates have been prepared assuming that ISV is selected as the remediation technology. This enabled the use of budget estimates from the ISV vendor, as well as the assumption that minimal site modifications would be necessary, since a new, “permanent” facility would not be required. It also enabled the assumption that the vitrified block would be left in place. Estimates done in this manner indicate project costs on the order of \$10 million. The estimates involve a mix of methods based on analogies with similar work.

The potential savings using ISV technology and current information therefore appear to be on the order of \$10 to \$15 million. At this early stage of the project, before conceptual design has been performed, estimates are of necessity on the order of $\pm 50\%$.

Benefit to the Project Baseline of Filling Need: Benefits to the Z-361 project from filling the need for demonstration of remediation technology are as follows:

Reduction in schedule vs. baseline; as an expedited response under CERCLA, demonstration of progress is important.

Reduction of personnel exposure due to elimination of removal of sludge from tank

Confirmation of safe process operation with surrogate materials

Acceptance of remediation process by client and upper management

Relevant PBS Milestones: This technology need is associated with PBS Milestone Number TRP-14-401, “Complete PFP Deactivation,” due September 30, 2016, and with TRP-14-501, “Complete PFP Yard Cleanup/Demolition,” due December 31, 2014.

Functional Performance Requirements: The Z-361 sludge may be contact handled; however, human entry into Z-361 is prohibited. Tank Z-361 is constructed of reinforced concrete, and is a rectangular

underground structure, 26 feet long, 13 feet wide and varying in depth from 17 feet at the inlet end to 18 feet at the outlet end.

The sludge in Tank Z-361, which is from wastewaters generated in PFP, was laid down in layers; consequently, there is considerable variability in its characteristics from layer to layer. The overall results indicate the following characteristics: 1) meets transuranic (TRU) mixed waste designation criteria (contains about 20,000 nCi/g TRU and toxic heavy metals), 2) is considered PCB-containing waste (>50 ppm PCB on two samples), 3) contains approximately 25 kilograms of plutonium 239 (about 30 kg of total fissile isotopes), 4) consists of about 70 m³ of sludge with some debris items, 5) has consistency of peanut butter or toothpaste and 6) is about 70% water. Significant amounts of highly reactive or combustible materials were not detected during sampling or analysis and thus are not expected.

Although the potential hazards associated with Z-361 do not appear to be nearly as serious as was hypothesized when the tank was first identified as a potential problem in 1997, two characteristics of the tank contents – the plutonium and the PCBs – are limiting factors in selecting appropriate remedial action.

Work Breakdown Structure (WBS) No.: 3.03.03.05.05.01

The Z-361 project is under Hanford WBS number 1.4.5.1.15.14.2.1, “Conduct Safe and Stable Actions for Other Yard Areas.”

TIP No.: N/A

Justification For Need:

Technical: The PFP Project cleanout efforts require remediation of the sludge.

Regulatory: The sludge in Tank Z-361 must be remediated in accordance with CERCLA. The U.S. Environmental Protection Agency has determined that the tank will be remediated as a non-time-critical removal action. There are also likely to be TPA milestones in the future for selected activities on remediation of Z-361.

Environmental Safety & Health: There will be a significant potential for exposure to alpha contamination with any remediation solution that requires removal of the sludge from the tank, whether for treatment, storage or final disposal. During the history of ISV development, there have been a few safety-related incidents. Demonstration of the safety performance of current vitrification techniques is needed in order to gain acceptance from the customer, contractor management and PFP staff.

Cultural/Stakeholder Concerns: Tank Z-361 sludge is an issue of concern to the regulators and the public. Status and plans for the tank have been on the agenda of the Hanford Advisory Board several times since the tank was first identified as a potential hazard in 1997.

Other: None identified.

Current Baseline Technology: Five end-state alternatives have been defined and assessed for remediation of the sludge in Tank Z-361; 1) dispose in place, 2) remove, treat, and dispose at WIPP, 3) remove and place in interim storage, 4) remove, process and dispose at ERDF, and 5) send to tank farms for processing with high-level waste sludges. Technologies for sludge removal (sluicing, mechanical) and for grouting wastes are well established, and demonstration is not expected to be necessary. However, ISV is not as mature or widely accepted as these other technologies, and there are safety concerns, which would be alleviated by a successful demonstration.

End-User: Technology for remediation of Tank Z-361 will be implemented by the Nuclear Material Stabilization Project.

Contractor Facility / Project Manager: The contractor responsible for the Nuclear Material Stabilization Project is Fluor Hanford, Inc. (FH).

Site Technical Point-of-Contact : Bryan K. (Keith) Hampton, Fluor Hanford (FH), (509) 373-1239, fax (509) 376-0045, bryan_k_keith_hampton@rl.gov

DOE End-User/Representative Point-of-Contact: Dr. Suzanne. E. Clarke (DOE-RL Project Manager) (509) 373-4931, fax (509) 372-3508, suzanne_e_clarke@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SURVEILLANCE OF GAS PRESSURIZATION DURING TRANSPORTATION AND STORAGE

General Reference Information		
1 *	<i>Need Title:</i> Surveillance of Gas Pressurization during Transportation and Storage	
2 *	<i>Need Code:</i> RL-02-023-NM	
3 *	<p><i>Need Summary:</i> Thermally stabilized plutonium bearing materials to be stored in 3013 containers are to be transported and stored for long periods of time awaiting final disposition by the Materials Disposition program. PNNL, Vista Technologies, and Fluor Hanford have developed (FY 2001) a remote (internal) pressure monitoring surveillance system for 3013 containers to be stored at PFP. A further need exists to modify or adapt this, or a similar pressure surveillance system that can continue to function while such system was contained within a 9975, Safkeg, or similar transportation container during the transportation phase – and/or during intermediate to long-term storage while the 3013 container while still within the transportation container. This transportation and storage surveillance system could be used during transportation and at Hanford, SRS, LANL, or other sites.</p>	
4 *	<i>Origination Date:</i> October 2001	
5 *	<i>Need Type:</i>	
6 *	<i>Operations Office:</i> Richland Operations Office	
7	<i>Geographic Site Name:</i> Hanford Site	
8 *	<i>Project:</i> Nuclear Material Stabilization	PBS No: RL-CP03
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>	
10	<i>Operations Office Priority:</i>	
Problem Description Information		
11	<i>Operations Office Program Description:</i>	
12	<i>Problem Description:</i>	
13	<i>Functional Performance Requirements:</i>	
14	<i>Definition of Solution:</i>	
15 *	<i>Targeted Focus Area:</i> NMFA	
16	<i>Potential Benefits:</i>	
17 *	<p><i>Potential Cost Savings:</i> Because a specific technology has not yet been selected for use in monitoring safety related parameters such as pressure for SNM containers during transportation and long term storage in 9975 transport containers, a direct cost savings cannot be calculated. However, the efficiency of a monitoring and surveillance system that uses remote sensing as</p>	

	compared to a system that could require opening and examining individual items stored in 9975 containers is obvious. Since there will be at least several thousand items in storage, originating from Hanford and from other DOE sites, a significant cost avoidance from avoiding extensive handling for surveillance is likely to accrue.
18 *	<i>Potential Cost Savings Narrative:</i> See 17 above.
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> TRP-14-401 Complete PFP Deactivation, 9/30/16
23 *	<i>Material Streams:</i> 3013's to SRS, stream #7235
24	<i>TSD System:</i> Input not required.
25	<i>Major Contaminants:</i>
26	<i>Contaminated Media:</i>
27	<i>Volume/Size of Contaminated Media:</i>
28 *	<i>Earliest Date Required:</i> 10/2009
29 *	<i>Latest Date Required:</i> 9/2014
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Technology Insertion Point(s): (as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> Dr. Suzanne. E. Clarke (DOE-RL Project Manager) (509) 373-4931, fax (509) 372-3508, suzanne_e_clarke@rl.gov
36	<i>Other Contacts:</i> M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_gibson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

INTERMEDIATE AND LONG-TERM SURVEILLANCE OF SAFEGUARDS FUNCTIONS

General Reference Information	
1 *	<i>Need Title:</i> Intermediate and Long-Term Surveillance of Safeguards Functions
2 *	<i>Need Code:</i> RL-02-024-NM
3 *	<i>Need Summary:</i> Thermally stabilized plutonium bearing materials are to be stored in 3013 containers for long periods of time awaiting final disposition by the Materials Disposition program. PNNL, Vista Technologies, and Fluor Hanford have developed (FY 2001) a remote (internal) pressure monitoring surveillance system for 3013 containers to be stored at PFP. A further need exists to enhance this pressure and safety monitoring surveillance system to incorporate safeguards monitoring functions for the storage container during storage. Desired safeguards functions include unique ID, radiation signature, integral diversion monitoring, and tamper indicators, that can be implemented periodically without complicated external equipment and the need to move the container to a test station location. This safeguards surveillance system could be used at Hanford, SRS, LANL, or other sites.
4 *	<i>Origination Date:</i> October 3001
5 *	<i>Need Type:</i>
6 *	<i>Operations Office:</i> Richland Operations Office
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Nuclear Materials Stabilization PBS No: RL-CP03
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i>
12	<i>Problem Description:</i>
13	<i>Functional Performance Requirements:</i>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> NMFA
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> Because a specific technology has not yet been selected for use in monitoring safeguards characteristics for SNM in 3013 containers during initial storage at the PFP, then during transportation and long-term storage in 9975 transport containers, a direct cost savings cannot be calculated. However, the efficiency of a monitoring and surveillance system

	that uses remote sensing as compared to a system that could require removing 3013 containers from storage, or opening and examining individual items stored in 9975 containers is obvious. Since there will be at least several thousand items in storage at the PFP, and at the SRS incremented by a similar number originating from other DOE sites, a significant cost avoidance from avoiding extensive handling for surveillance is likely to accrue.
18 *	<i>Potential Cost Savings Narrative:</i> See 17 above.
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> TRP-14-401 Complete PFP Deactivation, 9/30/16
23 *	<i>Material Streams:</i> 3013's to SRS, stream #7235
24	<i>TSD System:</i> Input not required.
25	<i>Major Contaminants:</i>
26	<i>Contaminated Media:</i>
27	<i>Volume/Size of Contaminated Media:</i>
28 *	<i>Earliest Date Required:</i> Could be implemented immediately
29 *	<i>Latest Date Required:</i> 9/2014
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> <i>Technology Insertion Point(s):</i> (as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> Dr. Suzanne. E. Clarke (DOE-RL Project Manager) (509) 373-4931, fax (509) 372-3508, suzanne_e_clarke@rl.gov
36	<i>Other Contacts:</i> M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark_w_gibson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

HYDROGEN SENSOR SYSTEM FOR TRANSPORTATION AND STORAGE CONTAINERS

General Reference Information	
1 *	<i>Need Title:</i> Hydrogen Sensor System for Transportation and Storage Containers
2 *	<i>Need Code:</i> RL-02-025-NM
3 *	<i>Need Summary:</i> A need exists in the NMFA complex to develop a hydrogen sensor system for transportation and/or storage containers for pure or impure plutonium oxides, residues, or other nuclear materials that do not currently meet the 3013 storage standard. The technical issue that must be addressed is for the periodic, remote surveillance of internal hydrogen concentration in the free space of the container, to provide a fail-safe safety assurance that it is less than 5%. The overall system needs to include specific hydrogen sensors and any external electronics needed to transmit the data signals. If possible, this system should be integrated with other ongoing initiatives to install other remote sensors for surveillance or monitoring functions such as pressure and safeguards parameters.
4 *	<i>Origination Date:</i> October 2001
5 *	<i>Need Type:</i>
6 *	<i>Operations Office:</i> Richland Operations Office
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Nuclear Materials Stabilization PBS No: RL-CP03
9 *	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> X </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i>
12	<i>Problem Description:</i>
13	<i>Functional Performance Requirements:</i>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Nuclear Materials Focus Area
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> Significant cost savings cannot be quantified yet for this monitoring technology.
18 *	<i>Potential Cost Savings Narrative:</i> The objective of the hydrogen monitoring system is to provide assurance that safety basis conditions can be maintained within SNM containers during storage and transportation. The use of a monitoring system gives a much stronger case for safe

	shipping and storage, and could avoid significant investment in more robust containers, smaller shipping quantities, and extensive safety analyses with related testing and qualification of residue gas generation rates.
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> TRP-14-401 Complete PFP Deactivation, 9/30/16
23 *	<i>Material Streams:</i> 3013's to SRS, stream #7235
24	<i>TSD System:</i> Input not required.
25	<i>Major Contaminants:</i>
26	<i>Contaminated Media:</i>
27	<i>Volume/Size of Contaminated Media:</i>
28 *	<i>Earliest Date Required:</i> Could be implemented immediately
29 *	<i>Latest Date Required:</i> 9/2014
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Technology Insertion Point(s): (as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> Dr. Suzanne. E. Clarke (DOE-RL Project Manager) (509) 373-4931, fax (509) 372-3508, suzanne e clarke@rl.gov
36	<i>Other Contacts:</i> M. W. Gibson, Fluor Hanford, Inc. (FH), (509) 373-4869, Fax (509) 372-0232, email mark w Gibson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

Spent Nuclear Fuel Project

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CANISTER STORAGE BUILDING (CSB) STORAGE VAULT INSPECTION

Identification No.: RL-SNF08

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: SNF-02, Dry K Basins Fuel, (Storage Tubes and Vaults)

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Canister Storage Building (CSB)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

_____	1. Critical to the success of the ACPC
_____	2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
<u> X </u>	3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Canister Storage Building (CSB) Storage Vault Inspection.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: A system that could be used to perform remote visual inspection (RVI) within the confines of Vault 1 at the Canister Storage Building (CSB) is needed during the interim storage period of the spent nuclear fuel. The system is to be used to check the long-term integrity of the canisters interim storage facility (i.e., CSB). Currently, no requirement for vault inspections exists; however it cannot be ruled out that some future upset conditions such as the occurrence of an earthquake would result in a desire to inspect the vault interior to confirm that no degradation resulted. Therefore, it is prudent for the SNF Project to perform advance planning for such inspections. Additionally, a determination of the most effective point-of-entry available to perform the examination is needed since currently no access into the vault exists or is planned.

Schedule Requirements:

Earliest Date Required: (10/2004)

Latest Date Required: (10/2010)

A system needs to be available to support inspection of CSB tubes and vaults in about 2004. This is when all of the multi-canister overpacks (MCOs) will have been placed in the tubes.

Problem Description: The Canister Storage Building (CSB) has been constructed in the 200 East Area of the Hanford Site to provide interim storage for spent nuclear fuel that will be removed from water-filled basins in the 100 K Area. The CSB is a 42,000-square foot, steel structure on a concrete operating deck.

The building is 60 feet tall in its aboveground areas. Three heavily reinforced concrete vaults are located below grade, each capable of holding 220 carbon steel tubes. The tubes, each 40 feet long, have been emplaced vertically in Vault I of the building, the only vault that will be equipped and utilized by the SNF Project. An impact absorber system has been built into the base of each tube to prevent damage to an MCO in the unlikely event that one is dropped while being placed in the tube. The tubes will be accessed through tube plugs in the operating deck of the CSB. The tubes are ½-inch thick carbon steel, with a plate welded on the bottom. The exterior walls of the CSB are 4 ½ feet (54 inches) thick. The CSB floor is 5 feet (60 inches) thick reinforced concrete, and has more densely packed rebar than the walls.

The CSB facility itself is designed to operate for 40 years, and it is possible that remote visual inspections (RVI) may be required throughout that period. The purpose of the inspection is to examine the interior of CSB Vault 1 for visual indication of pooled/standing water, water ingress, degradation of concrete in the vault floor and structure, and deterioration of the multi-canister overpack (MCO) storage tubes. The intent is to examine the plenum area beneath the air inlet shaft, the front face of the MCO storage tubes and possibly a portion of the standard storage tubes. Inspection criteria (percent examination area, flaw-size detectable, RVI equipment performance, etc.) have not, however, been finalized.

The storage vault itself is specifically engineered to prohibit, rather than promote, entry, and was designed without consideration for repeatable access. These two factors increase the complexity of the task and will make the inspection difficult. Additionally, there are no orientation landmarks or directional indicators within the vault to provide a visual reference, and the storage tubes themselves are not individually identified.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Baseline for outyear operating costs for the CSB are not fully established at a level that would provide an estimate that could be required for this activity. A rough order of magnitude (ROM) cost for this activity is \$200K. Improved technology could reduce cost by roughly 50% for a savings of \$100K.

Benefit to the Project Baseline of Filling Need: RVI equipment provides a means to visually examine the interior of normally inaccessible areas and eliminates the need for human entry into hazardous environments. By employing specialized optical-mechanical devices, an operator can perform such inspections at a safe distance away from associated work hazards.

Relevant PBS Milestone: N/A

Functional Performance Requirements: The operating environment within Vault 1 will be both thermally and radiologically hot, therefore, an inspection performed remotely will be required. Minimum size of visual detectability and extent of coverage (examination area) to be inspected have not been finalized.

Work Breakdown Structure (WBS) No.: 1.03.02.01.20

TIP No.: N/A

Justification For Need:

Technical: It cannot be ruled out that some future upset conditions such as the occurrence of an earthquake would result in a desire to inspect the vault interior to confirm that no degradation resulted.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety & Health: There are no environmental safety and health issues of concern with this technology need.

Cultural/Stakeholder Concerns: The Defense Nuclear Facilities Safety Board (DNFSB) staff raised the issue of performing inspections of Vault 1 at the CSB.

Other: None identified.

Current Baseline Technology: N/A

End-User: Canister Storage Building

Contractor Facility/Project Manager: SNF Process Engineering, Jim McClusky, Fluor Hanford (FH), (509) 373-2281, Fax (509) 373-1542, James_K_McClusky@rl.gov.

Site Technical Points-of-Contact: Bruce Makenas, Fluor Hanford (FH), (509) 376-5447, Fax (509) 376-8027, Bruce_J_Makenas@rl.gov, Jim Sloughter, Numatec Hanford Corporation (NHC), (509) 373-0591, Fax (509) 372-1542, James_P_Sloughter@rl.gov.

DOE End-User/Representative Point-of-Contact: Steve J. Veitenheimer, DOE-RL, (509) 373-9725, fax (509) 373-9837, Steve_J_Veitenheimer@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED MULTI-CANISTER OVERPACK (MCO) GAS SAMPLING SYSTEM

Identification No.: RL-SNF09

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: SNF-02, Dry K Basins Fuel, Multi-Canister Overpacks (MCOs)

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Canister Storage Building (CSB)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

- ☐ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved Multi-Canister Overpack Gas Sampling System.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: The Tri Party Agreement schedule requires the removal of spent nuclear fuel from the K Basins and its dry storage at the Canister Storage Building (CSB). The CSB will receive, stage, and store approximately 400 Multi-canister overpacks (MCO), each of which will contain five or more metric tons of vacuum dried, metal-form Spent Nuclear Fuel (SNF) under an eleven psig (nominal) helium cover. The project baseline seals the fuel in welded MCOs for interim storage. Once MCOs have been placed into storage at the CSB there is no safety requirement, regulatory requirement or precedent to monitor them. Although not required, acquiring data at a reasonable cost that may be useful in developing a fuller understanding of the behavior of an engineered system is good engineering practice. Therefore, a limited program is needed to observe pressure/temperature/gas composition relationships in a small number of MCOs during the first two years in storage.

A sampling cart has been built to monitor some of the MCOs during the first year of storage to verify performance. The unit weighs approximately 1 ton. The current technology could be improved, for example, by utilizing a more compact unit that is capable of taking smaller samples in a manner that prevents a major flush and refill of the MCO gas. Therefore, it is desirable to identify an alternative to the planned baseline technology/process.

Schedule Requirements:

Earliest Date Required: (03/2001)

Latest Date Required: (06/2001)

Monitoring must be completed in time to weld the MCO closure and store the monitored MCO prior to SNF Project completion.

Problem Description: The MCO monitoring activity objective is to obtain data on the actual behavior of stored MCOs. The MCO must be removed from the storage tube and moved to the weld station to be sampled. The MCO can have significant amounts of hydrogen gas in the sample as well as fission gases of Xenon. The hydrogen to xenon ratio is an important parameter as well as the helium to hydrogen ratio. The current SAR does not allow a vacuum to be pulled in the MCO port valve in CSB, which complicates the sampling process by conventional means. Also, a minimum of 30.27 gmoles of helium must be maintained in an MCO. Once sampling has occurred, it is difficult to determine the amount of remaining helium in an MCO since the temperature of the MCO cannot be controlled accurately. Technology to sample the MCO does exist if a vacuum can be pulled on the MCO port valve.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Cost savings are associated with sampling six MCOs on a quarterly basis for two years. Approximate cost is \$20K per year. Obtaining a sample from an MCO is currently very time consuming, and involves opening an MCO valve that has a limited number of cycles before the seal must be changed. Cost savings are realized from eliminating the refilling of an MCO with inert gas. Improved technology could reduce cost by 50 % for a savings of \$40,000 over the projected four years sampling will be conducted.

Benefit to the Project Baseline of Filling Need: The biggest risk in the current approach is losing the helium pressure on a MCO in the CSB, which is a Technical Safety Requirement Violation. The second problem is the current system draws too large of a volume of helium and is much larger than required to obtain a laboratory scale sample and requires fresh helium to be introduced into the MCO. The new system would eliminate the need for refilling with helium and pull a small laboratory scale sample.

Relevant PBS Milestone: S00-01-909 - Complete Spent Nuclear Fuel Project

Functional Performance Requirements: The MCO monitoring activity will permit acquisition of temperature, pressure, and gas composition data from a small number of MCOs over a limited period of time using non-intrusive, cost-effective data acquisition methods. The proposed approach would monitor 4 to 6 MCOS for up to two years. The designated MCOs would be staged and configured to permit monitoring, via engineered connections to ports in the mechanical closure head. Temperature and pressure will be recorded frequently. The pressure range of interest is 0 to 50 psig, with 2% accuracy. The temperature range of interest is 0 to 120°C, with accuracy within 2°C.

Gas sampling is proposed no more frequently than quarterly, with removal of a sample through a simple connection to the MCO.

Work Breakdown Structure (WBS) No.: TBD

TIP No.: N/A

Justification For Need:

Technical: Previous investigations have been limited to small fuel samples or simulant prototypes and have been relatively short in duration. MCO monitoring can provide data on large loads of actual fuel, in full-scale configuration, over longer time periods. Additional knowledge of this fuel type may prove valuable in future analyses or applications.

Regulatory: N/A

Environmental Safety & Health: N/A

Cultural/Stakeholder Concerns: Monitoring is of interest to the DNFSB.

Other: None identified.

Current Baseline Technology: The gas sampling activities will be performed within the CSB's "Sampling/Weld Area. A Sampling Cart will be used during all MCO sampling operations and is designed to provide a mobile storage location for the components required to: 1) determine MCO internal pressure, 2) sample the MCO internal atmosphere (for lab analysis), and 3) refill the MCO with inert gas following the sampling operations to ensure a positive pressure (nominally at 9.0 - 30.0 psig) during MCO storage.

End-User: Canister Storage Building.

Contractor Facility/Project Manager: SNF Process Engineering, Jim McClusky, Fluor Hanford (FH), (509) 373-2281, Fax (509) 373-1542, [James K McClusky@rl.gov](mailto:James_K_McClusky@rl.gov).

Site Technical Points-of-Contact: Bruce Makenas, Fluor Hanford (FH), (509) 376-5447, Fax (509) 376-8027, [Bruce J Makenas@rl.gov](mailto:Bruce_J_Makenas@rl.gov); Jim Sloughter, Numatec Hanford Corporation (NHC), (509) 373-0591, Fax (509) 372-1542, [James P Sloughter@rl.gov](mailto:James_P_Sloughter@rl.gov)

DOE End-User/Representative Point-of-Contact: Steve J. Veitenheimer, DOE-RL, (509) 373-9725, fax (509) 373-9837, [Steve J Veitenheimer@rl.gov](mailto:Steve_J_Veitenheimer@rl.gov)

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

MULTI-CANISTER OVERPACK (MCO) INTERROGATION METHOD

Identification No.: RL-SNF10

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: SNF-02, Dry K Basins Fuel, Multi-Canister Overpacks (MCOs)

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Canister Storage Building (CSB)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

_____	1. Critical to the success of the ACPC
_____	2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
<u> X </u>	3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Multi-Canister Overpack Interrogation Method.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: An apparatus to interrogate stainless steel fuel canisters which contain uranium metal fuel, residual water and corrosion products such as hydrogen is needed to measure hydrogen pressure, water content, etc.

Schedule Requirements:

Earliest Date Required: (1/2005)

Latest Date Required: (01/2007)

Repository may be able to accept fuel as early as 2007.

Problem Description: The Tri Party Agreement schedule requires the removal of spent nuclear fuel from the K Basins and its dry storage at the Canister Storage Building (CSB). The project baseline seals the fuel in welded canisters called multi-canister overpacks (MCOs) for interim storage. Technology is needed to ascertain the condition of MCOs after long-term storage and process the MCOs as necessary for acceptance at a permanent repository.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Zero cost savings are currently projected. Benefits will assist in determining need for additional processing to meet repository waste acceptance criteria.

Benefit to the Project Baseline of Filling Need: Data obtained from the interrogation method will provide means for determining if the MCOs required further processing to meet repository waste acceptance criteria.

Relevant PBS Milestone: N/A

Functional Performance Requirements: A method for interrogating the MCOs will be needed to demonstrate that the waste packages meet the repository acceptance criteria. The results of the interrogation may additionally require that the MCOs be processed (e.g., vented of internal pressure and back-filled) prior to shipment. Baseline technologies for the requisite handling, interrogating, and processing have not been selected. Repository acceptance requirements have not been finalized.

Work Breakdown Structure (WBS) No.: 1.03.02.01.10

TIP No.: S20-10-010

Justification For Need:

Technical: Technology to interrogate the MCOs will provide data required by the repository for waste acceptance (i.e., pressure buildup [hydrogen] from water, corrosion processes, etc.). The data will also determine if further processing of the MCOs will be required to meet the repository waste acceptance criteria.

Regulatory: Interrogation of the MCOs will serve as a basis for determination of compliance with repository waste acceptance criteria.

Environmental Safety & Health: Technology that demonstrates the MCOs are acceptable at the national geologic repository without further processing would reduce the health, and safety risks to personnel and the environment.

Cultural/Stakeholder Concerns: The expectation of the stakeholders is that the Spent Nuclear Fuel will be sent to an off-site repository for long-term storage.

Other: None identified.

Current Baseline Technology: N/A

End-User: Canister Storage Building.

Contractor Facility/Project Manager: SNF Process Engineering, Jim McClusky, Fluor Hanford (FH), (509) 373-2281, Fax (509) 373-1542, James_K_McClusky@rl.gov

Site Technical Points-of-Contact: Bruce Makenas, Fluor Hanford (FH), (509) 376-5447, Fax (509) 376-8027, Bruce_J_Makenas@rl.gov; Jim Sloughter, Numatec Hanford Corporation (NHC), (509) 373-0591, Fax (509) 372-1542, James_P_Sloughter@rl.gov

DOE End-User/Representative Point-of-Contact: Steve J. Veitenheimer, DOE-RL, (509) 373-9725, fax (509) 373-9837, Steve_J_Veitenheimer@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SNF SLUDGE STORAGE AND MONITORING SYSTEM

Identification No.: RL-SNF14

Date: October 2001

Program: Spent Nuclear Fuels (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: RL-HLW-21, SNF Basin Sludge

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: K-Basin

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

☐
☒
☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|---|

Need Title: SNF Sludge Storage and Monitoring System.

Need/Opportunity Category: *Technology Opportunity* -- The site desires an alternative to the current baseline technology.

Need Description: The K-Basin's sludge (~52 m³) needs to be removed from the K Basins prior to decontamination and decommissioning (D&D). The sludge, which contains some reactive metal uranium fuel fragments, needs to be retrieved, and placed in appropriate vessels for shipment to and interim storage at T-Plant. Ultimately, the sludge will be treated and dispositioned to WIPP. A cost effective method and supporting technical basis and safety analysis is needed so that the sludge can be easily and safely stored and monitored before sludge treatment and disposition to WIPP.

Schedule Requirements: The sludge needs to be removed from K Basins prior to August 2004 to comply with the Tri-Party Agreement milestone pertaining to removal of sludge and debris. Initial operation is scheduled for the end of December 2002.

Problem Description: Metallic uranium Spent Nuclear Fuel (SNF) currently is stored in two water-filled concrete pools, 105-KE Basin (KE Basin) and 105-KW Basin (KW Basin), at the United States Department of Energy (U. S. DOE) Hanford site. These fuel storage pools also contain sludge containing hazardous substances that primarily result from the degradation of the SNF. In the past, large quantities of contaminated water leaked from the basins into the underlying soil and groundwater. Because of this, the U.S. Department of Energy-Richland Operations Office has determined that the hazardous substances stored in the basins present a potential threat to human health and the environment, and that a non-time-critical removal action conducted under CERCLA is warranted to reduce this threat. The SNF Project mission includes safe removal and transportation of all sludge from these storage basins to a more secure

storage state in the 200 West Area (currently identified as T Plant). The sludge is any material in the K Basins pools that is less than or equal to 0.64 cm (0.25 in.) in diameter and is removed from the basin as a bulk waste. The sludge is a combination of sand, dirt, fuel corrosion products, paint chips, corrosion products from racks and canisters and other hardware in the basins. Some pieces of unoxidized metal fuel or hydride also are likely to be present. Some sludge is contaminated with polychlorinated biphenyls (PCB).

Uranium metal reacts with water liberating hydrogen gas and energy. The rate of this reaction increases exponentially with temperature. Consequently, to maintain thermal stability, the sludge must be transported and stored in systems designed to provide a rate of heat removal that prevents the temperature in the sludge from increasing significantly.

The K Basin sludge will be segregated into two general types (Type I and Type II) based on the expected uranium metal content. The current conceptual design calls for the higher uranium metal content sludge (Type II) to be loaded into vessels, which will be stored in a water-filled pool at T Plant that operates at conditions similar to those at the K Basin Pools. The baseline plan for Type I sludge, which consists primarily of sludge with lower uranium metal content from the K Basins floor and pits, is to load it into vessels and store the vessels in air within T Plant.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The total cost for retrieval and storage of the sludge is estimated to be \$40M. Considerable cost saving could be realized by elimination of the need to store the sludge in water filled pools, establishing an automated monitoring system, and using large commercially available transport and storage containers.

Elimination of the need for the T Plant pool for storage of Type II K Basins sludge may save several million dollars. Use of a smaller number of large, near-commercial vessels (e.g., High Integrity Containers) for storage of K Basin sludge may save several million dollars compared to 10 in. and 24 in. diameter vessels in the current project baseline. The technical issue to be overcome is to provide a technical basis for the safety analysis that can assure thermal stability in the transport/storage container and air storage. Increased characterization knowledge and modeling of critical parameters such as thermal conductivity and uranium metal distribution is required to support change of the technical baseline.

Deployment of an automated monitoring system may save several million dollars over the baseline plan of weighing the vessels each quarter with a crane and load cell. Furthermore, an automated monitoring system would provide substantial risk reduction by providing early detection of instability within a sludge storage vessel.

These cost savings are based on previous cost estimates and engineering judgment. The accuracy of these savings are probably plus or minus 50%.

Benefit to the Project Baseline of Filling Need: Demonstration of the viability of the use alternate storage methods will simplify design, procurement, and reduce handling requirements. It is expected that the use of a larger volume storage system will provide improvements to the schedule for removing the sludge from the K Basins.

Relevant PBS Milestone: TBD

Functional Performance Requirements: A sludge storage system is necessary that can be loaded remotely in a high-radiation environment, reject heat generated for uranium metal oxidation, preclude segregation of metallic uranium, and allow monitoring to assure that the sludge is covered with a head of water.

Work Breakdown Structure (WBS) No.: TBD

TIP No.: N/A

Justification For Need:

Technical: The K-Basin's sludge must be removed from the basin in order to D&D the facility.

Regulatory: Tri-Party Agreement milestones are as follows:

M-34-08: July 31, 2004, Initiate K East Basin sludge removal.

M-34-10: August 31, 2005, Complete K-Basin's sludge removal.

Environmental Safety & Health: N/A.

Cultural/Stakeholder Concerns: N/A.

Other: None identified.

Current Baseline Technology: Storage of K Basin sludge at T Plant in 10 in. and 24 in. diameter, custom designed storage vessels. The T-Plant Pool will be used for storage of higher uranium metal content sludge. It is planned to monitor the water level inside the vessels with a crane and weigh cell.

End-User: SNF Project, Wally Rutherford, Fluor Hanford (FH), (509) 372-2903; Fax (509) 372-3655, W Wally Rutherford@rl.gov

Site Technical Points-of-Contact: Bruce Makenas, Fluor Hanford (FH), (509) 376-5447, Fax (509) 376-8027, Bruce J Makenas@rl.gov; Jim Sloughter, Numatec Hanford Corporation (NHC), (509) 373-0591, Fax (509) 372-1542, James P Sloughter@rl.gov

DOE End-User/Representative Point-of-Contact: Steve J. Veitenheimer, DOE-RL, (509) 373-9725, fax (509) 373-9837, Steve J Veitenheimer@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROCESS TECHNOLOGY FOR DRYING SPENT NUCLEAR FUEL

Identification No.: RL-SNF-15

Date: May 2001

Program: Spent Nuclear Fuels (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: SNF-02 Dry K Basin Fuel

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Cold Vacuum Drying Facility, Canister Storage Building

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

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☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|--|

Need Title: Process Technology for Drying Spent Nuclear Fuel

Need/Opportunity Category: *Technology Opportunity* -- The site desires an alternative to the current baseline technology / process.

Need Description:

A high through put drying process (improved over current vacuum drying technology) and the scientific/kinetic data to justify safe implementation are needed in order to process N reactor metallic uranium fuel.

The Hanford Spent Nuclear Fuel Project is addressing the urgent need to move spent fuel from the present degraded wet storage conditions in the 105 K East (KE) and the 105 K West (KW) Basins in the 100 K Area on Hanford's Central Plateau. About 80% (by weight) of the entire U.S. Department of Energy's (DOE) Spent Nuclear Fuel inventory is located at the Hanford K Basins. Fuel stored in the basins exists in a degraded state and continues to corrode. The Spent Nuclear Fuel Project is removing the spent fuel from the water storage in the K-Basins, applying a cold vacuum drying (CVD) process and placing the fuel into interim dry storage until a national geologic repository is available.

To meet schedule commitments, the work in progress must be accelerated. It is anticipated and expected that operations will become more efficient with time as the project gains experience with the fuel handling/processing systems. However, there may be ways to improve the current fuel drying process that have not been evaluated and there might also be alternatives to the cold vacuum drying process that could reduce the time to complete fuel drying.

Schedule Requirements:

Earliest Date Required: 10/1/2002

Latest Date Required: 06/01/2003

The spent fuel presently stored in the K-Basins must be removed from the basins, packaged, dried, and transferred to the Canister Storage Building by July 31, 2004 (TPA milestone M-34-18B, and DNFSB Commitment Number 118E). Early demonstration of alternative fuel drying strategies is desirable.

Problem Description: Presently, the steps for cold vacuum drying (CVD) of the fuel contained in MCOs may be summarized as:

1. The void space in each MCO is initially full of basin water when a MCO arrives at the CVDF. The MCO is first heated to about 50°C using this water as a heat transfer media.
2. The majority of the free water is then removed by pressurizing the MCO with inert gas. The water is removed via a dip tube that reaches from the top of the MCO to the bottom.
3. The vacuum drying process is initiated while heat is continually applied to the MCO by a water-filled heating jacket to keep the contents near 50°C. The vacuum is maintained for about 16 hours.
4. Following vacuum drying the MCO is isolated from the vacuum system and a “pressure rebound” test is performed. This is simply a test to observe the rise in pressure that may arise as any residual water turns to gas at the reduced pressure within the MCO.
5. The MCO is then purged with helium gas for several hours, evacuated again, and then subjected to another pressure rebound test.
6. Following purging and successful completion of the rebound tests, the MCO is sealed and transferred from the CVDF to the CSB for interim storage.

Operational improvements may be possible by increasing the temperature at which the drying is conducted. However, the potential accident scenarios evaluated during the development of the Safety Basis for the Safety Analysis Report (SAR) for the CVDF established the temperature presently used. These accidents included the potential for run-away oxidation events involving breached/corroded fuel elements, fuel pieces, scrap, and sludge particulates during drying when any exposed uranium metal could potential react with water vapor.

The understanding of the reactivity of the water stored and degrade uranium fuel found in the K-Basins is limited. Literature data regarding the oxidation of uranium have a large standard deviation, and most reported data are for unirradiated uranium that has not been stored in water. It is known the damaged/degraded K-Basin fuel is cracked and fissured and contains uranium hydride. Limited characterization data obtained by the project in the 1990s suggests the degraded fuel may react more rapidly than unirradiated uranium, but the large scatter of the literature data makes a conclusion regarding the expected performance of the K-Basin fuel difficult. Thus, the project had to develop the drying process with sufficient conservatism (i.e. a relatively low drying temperature) to insure the safety of the system.

To reduce the conservatism in the drying temperature, additional data regarding the oxidation rate of water-stored and degraded uranium in water vapor is needed. If it can be shown the oxidation rate of the uranium in water vapor at temperatures between 50 and 100°C is not significantly different from literature values, then it may be possible to justify a rise in the drying temperature. The time to dry a MCO could be reduced by several hours to one day if the drying temperature could be raised by 10 to 25°C.

Additional schedule improvements can be achieved if alternative-drying techniques can be employed. The CVD process for drying uses a vacuum to reduce the risk of uranium oxidation events. While this insures safety for the drying of breached and degraded fuel elements, it is known (through extensive in-

basin visual examinations and from the handling of the fuel loaded into the first ten MCOs) that a vast majority of the fuel elements contained in the K-Basins are virtually intact. These intact fuel elements have no or little exposed uranium and do not pose a reactivity problem that would jeopardize safety. Because each fuel element is inspected prior to loading in a MCO, it is possible to load entire MCOs with intact fuel. It may be possible to dry these MCOs using a flowing gas process that does not require a complicated vacuum system. Removal of these MCOs from the CVD process could save substantial amounts of time. It is estimated that up to 80% of the fuel elements in the K-Basins may be intact. The CVD process could be used to dry damaged fuel, scrap, and sludge particulates, while an alternative process could be used to dry the intact fuel elements.

Proposed improvements to the process must be accompanied by sufficient data to ensure that the Safety Basis accident analyses can be revised and the SAR for the CVDF successfully updated. Additionally, a proposal to allow an increase in the residual water remaining in a MCO after drying would also require sufficient data to support a reanalysis of the Safety Basis for the CVDF. Alternative drying strategies to the CVD process must also be accompanied by sufficient data to support the development of the safety basis for the proposed process. It is anticipated that a ¼ to full-scale demonstration of a new process may be required to demonstrate the effectiveness of an alternative drying process.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: If the Spent Nuclear Fuel Project cannot complete the removal of fuel from the K-Basins and transfer it to dry interim storage by July 31, 2004, the project will incur additional costs of about \$500K per day for each day over schedule.

Benefit to the Project Baseline of Filling Need: Acceleration of the fuel drying process is critical for meeting the project milestone commitments to complete the transfer of the K-Basin fuel to dry interim storage.

Relevant PBS Milestone: N/A

Functional Performance Requirements: Improvements to the CVD fuel drying process must be justified by sufficient data to support the revision of the Safety Basis for the process. Thus, data provided must be sufficient to support a stated hypothesis (e.g. a rise in the drying temperature of several degrees can be safely performed) with a stated statistical confidence factor that is based on data reproducibility, range of conditions, etc.

Similarly, any proposal for an alternative drying process must also be accompanied by sufficient data to support the development of a safety basis for the proposed process. Although laboratory-scale demonstration using surrogate spent fuel assemblies might be sufficient, it is anticipated that a ¼ to full-scale demonstration may be required to gather the data needed.

Work Breakdown Structure (WBS) No.: TBD

TIP No.: TBD

Justification For Need:

Technical: Acceleration of the process used to dry the fuel being removed from the K-Basins is essential to meet programmatic commitments and critical TPA milestones. Time can be saved in the drying process if the temperature of the process can be raised, but the data required to justify a temperature increase are not presently sufficient. Further, alternative-drying strategies may be possible to eliminate the need for vacuum drying of the majority of the fuel.

Regulatory: TPA milestone M-34-18B

Environmental Safety & Health: N/A

Cultural/Stakeholder Concerns: N/A

Other: DNFSB Commitment Number 118E

Current Baseline Technology: The current baseline technology used to dry the K-Basin fuel is described in the Problem Description section.

End-User: Cold Vacuum Drying Facility and Canister Storage Building Operations

Contractor Facility/Project Manager: SNF Process Engineering, Jim McClusky, Fluor Hanford (FH), (509) 373-2281, Fax (509) 373-1542, James_K_McClusky@rl.gov.

Site Technical Points-of-Contact: Bruce Makenas, Fluor Hanford (FH), (509) 376-5447, Fax (509) 376-8027, Bruce_J_Makenas@rl.gov; Jim Slougher, Numatec Hanford Corporation (NHC), (509) 373-0591, Fax (509) 372-1542, James_P_Slougher@rl.gov.

DOE End-User/Representative Point-of-Contact: Steve J. Veitenheimer, DOE-RL, (509) 373-9725, fax (509) 373-9837, Steve_J_Veitenheimer@rl.gov

WESF

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CESIUM/STRONTIUM CAPSULE LEAK DETECTION SYSTEM FOR WESF

Identification No.: RL-DD01

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 2115 – Cs/Sr Capsules

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Waste Encapsulation Storage Facility (WESF)

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Cesium/Strontium Capsule Leak Detection System for WESF

Need/Opportunity Category: *Technology Need* -- There is no currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: WESF is a TSD permitted facility for storage of the dangerous wastes associated with radioactive cesium and strontium salts. The cesium salts are contained in double wall stainless steel capsules and the strontium salts are contained in double wall Hastalloy and stainless steel capsules. There are 1,936 capsules stored under 13 feet of water in 6 pool cells. Capsule storage began in 1974 and will continue through 2017, at which time they will be turned over to the High Level Waste Disposal Program. WESF is required by WAC 173-303-630(2) to identify and move any capsules from the pool cells that begin to leak. WESF does not currently have an effective monitoring system that will quickly (within 24 hours) identify a leaking capsule(s) allowing removal from the pool cell for repackaging. The need exists for an effective monitoring system to locate a leaking capsule under 13 feet of water (There is also a separate need for an improved method to determine capsule integrity to reduce the risk of a leak occurring, which is presented in RL-DD041).

Schedule Requirements:

Earliest Date Required: ASAP

Latest Date Required: 10/01/10

Technology should be deployed immediately. The current baseline for the capsules is to continue storing the capsules at WESF pending final disposition. The current disposal option is to process the contained cesium and strontium with existing Hanford Site Tank Farm high-level waste at the Hanford Vitrification facility in the 2013 to 2017 time frame. The technology could be used over the long term (20 years).

Note: A change request is currently pending that would delay the 2017 date until the end of FY 2022, with processing starting in 2018.

Problem Description: WESF stores strontium and cesium capsules in pool cells that were constructed to provide shielding and cooling for approximately 1,900 capsules. The cesium salts are double encapsulated in 316L stainless with welded end caps. The strontium salts are double encapsulated in 316L stainless outer capsules and Hastelloy C-276 inner capsules with welded end caps. There are 6 pool cells that are actively storing capsules, each measuring approximately 4.5 ft x 20 ft x 13 ft (deep). Each active pool cell has a water beta monitoring system to detect the loss of capsule integrity in that pool. Cesium chloride and, to a lesser degree, strontium fluoride are soluble in water. A significant leak could contaminate the pool in the matter of hours. Once the pool is contaminated, it will be difficult to identify the leaking capsule beneath 13 feet of water.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:
None.

Benefit to the Project Baseline of Filling Need: Reduced risk of storage basin contamination.
Relevant PBS Milestone: N/A

Functional Performance Requirements: There is need for an easily deployable technology that will allow for rapid underwater identification of a single leaking capsule. With the online Beta Monitors, a leak will be detected when concentrations in the pool reach 23.6×10^{-6} microCi/ml for Sr-90 or 47.2×10^{-6} microCi/ml for Cs-137. The technology is needed to identify the leaking capsule beneath 13 feet of water at these minimum concentrations. The technology must be operable in a high-radiation environment. The exposure rate of a single submerged cesium capsule, which contains 50 kilocuries, is 200 rem per second on contact.

Work Breakdown Structure (WBS) No.: 1.4.2

TIP No.: Candidate

Justification For Need:

Technical: Rapid identification and removal of a leaking capsule would minimize pool cell contamination and the need for subsequent pool cell cleanup.

Regulatory: N/A.

Environmental Safety & Health: Worker safety would be improved by the provision of an improved method to quickly identify a leaking capsule. This would allow the capsule to be more quickly moved from the pool to an alternative shielded location, which would minimize the risk of pool cell decontamination and worker exposure.

Cultural/Stakeholder Concerns: Rapid identification would reduce the risk of employee exposure to any unexpected release of toxic and/or radioactive materials and it would reduce the quantities of materials handled, stored, or disposed of as a secondary waste product.

Other: None identified.

Current Baseline Technology: Each active pool cell has a water beta monitoring system that will detect when a capsule has failed and radioactive materials have migrated into the water. The system, however, is

not adequate to permit isolation of an individual leaking capsule. The current plan to identify a possible leaking capsule is to perform an inner capsule movement test in which each capsule is manually lifted and shaken with the use of a special tool. Identification of a leaking capsule by this technique could require several days. In the event of a catastrophic failure, dosages would be too high to permit such a test.

End-User: EM-60

Contractor Facility/Project Manager: Brian Oldfield, Fluor Hanford, Inc. (FH), (509) 373-2707, Fax: (509) 372-0264, Brian_Oldfield@rl.gov.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov; Steve Lowe, FH, (509) 373-0646, Fax (509) 372-1441, Steven_S_Steve_Lowe@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CAPSULE INTEGRITY ASSESSMENT METHOD FOR WESF

Identification No.: RL-DD041

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 2115 – Cs/Sr Capsules

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Waste Encapsulation Storage Facility (WESF)

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

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☐ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
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Need Title: Capsule Integrity Assessment Method for WESF.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: The Waste Encapsulation and Storage Facility (WESF) stores approximately one-third of the total curies of the Hanford Site's radioactive material in the form of cesium and strontium capsules. Approximately 68 million curies of cesium-137 and strontium-90 by-product are contained in the 1,936 capsules presently stored in the WESF basins under 13 feet of deionized water. There is need for an improved method to determine capsule integrity to reduce the risk of a leak occurring. (There also is a separate need for an effective monitoring system to identify a leaking capsule should a leak actually occur. This need is presented in RL-DD01.)

New technology would better assess the integrity of the WESF capsules. The technology/ method would increase the technical basis for assessing the structural integrity of the inner container. Monitoring the capsule integrity over the next 20 years is required to ensure worker safety and safety to the public and the environment.

Schedule Requirements:

Earliest Date Required: ASAP

Latest Date Required: (10/01/17)

This technology could be deployed immediately. The current baseline for the WESF facility is to continue storing capsules until their final removal in 2017. Deactivation activities would begin soon

thereafter. Note: A change request is currently pending that would delay the 2017 date until the end of FY 2022.

Problem Description: WESF stores strontium and cesium capsules in pool cells that were constructed to provide shielding and cooling for approximately 1,900 capsules. There are 6 pool cells that are actively storing capsules, each measuring approximately 4.5 ft x 20 ft x 13 ft (deep).

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:
No cost saving is projected.

Benefit to the Project Baseline of Filling Need: Reduced risk of storage basin contamination.

Relevant PBS Milestone: N/A

Functional Performance Requirements: The technology and method should allow for an underwater, and non-invasive assessment of the individual capsules (approximately 1,900 capsules are stored in 5 pools) to detect failure, either in the form of corrosion of the inner capsule or the presence of salt in the annulus. The underwater depth is 13 feet. The capsules cannot be lifted more than 30 inches from the bottom of the pool. This technology must be operable in a high radiation environment. The exposure rate of a single submerged cesium capsule, which contains 50 kilocuries is 200 rems per second at contact and 11 rems per second at 24 inches.

Work Breakdown Structure (WBS) No.: 1.4- WESF Sub-Project

TIP No.: Candidate

Justification For Need:

Technical: Rapid identification of reduced capsule integrity would help to identify problems before onset of a leak. Ideally, this would minimize pool cell contamination and the need for subsequent pool cell cleanup. A successful technology could significantly reduce worker exposure and eliminate the man-hours spent on the regularly scheduled clunk tests.

Regulatory: WESF is under interim status with a Part A permit for miscellaneous storage of containers. The inner capsule is considered to be the container and as such must be inspected weekly for degradation of integrity. WAC 173-303-630(6).

Environmental Safety & Health: Worker safety would be improved by the provision of an improved capsule integrity assessment technology and method. Early leak detection would minimize the risk of worker exposure for pool cell decontamination.

Cultural/Stakeholder Concerns: Early indications of reduced capsule integrity would reduce the risk of employee exposure that could eventually result from an unexpected release of toxic and/or radioactive materials and it would reduce the quantities of materials handled, stored, or disposed of as a secondary waste product.

Other: None identified.

Current Baseline Technology: The ability to detect radioactive material in the capsule

End-User: EM-60.

Contractor Facility/Project Manager: Brian Oldfield, Fluor Hanford, Inc. (FH), (509) 373-2707, Fax: (509) 372-0264, Brian_Oldfield@rl.gov.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov); Steve Lowe, FH, (509) 373-0646, Fax (509) 372-1441, [Steven S Steve Lowe@rl.gov](mailto:Steven_S_Steve_Lowe@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

FY 2002 NUCLEAR MATERIALS STABILIZATION SCIENCE NEEDS

SCIENCE NEEDS/OPPORTUNITIES STATEMENT

OXIDATION AND HYDRIDE FORMATION IN U METAL SNF

Identification No.: RL-SNF13-S

Date: November 2000

Program: Spent Nuclear Fuel (SNF)

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-RS03

Waste Stream: SNF-02 Dry K Basin Fuel

TSD Title: N/A

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Canister Storage Building, Future Hanford Fuel Transfer Facility, and National SNF Repository

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

- ☐ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Oxidation and Hydride Formation in U Metal SNF

Need/Opportunity Category: Science Need

Need Description: However the damage to fuel caused by handling, irradiation and years of under-water storage may have an effect on the rates of oxide and hydride formation in SNF and thereby the rate of hydrogen generation from the corrosion processes. Hydride formation may also be a source of fine reactive particulate that must be considered if fuel canisters are to be opened or canister breach accidents are to be analyzed. Uncertainties in oxidation behavior for interim storage of fuel on the Hanford Site are currently dealt with by applying conservative multiplication factors to calculations that involve chemical reactions.

At the present time, canisters containing metal fuel are not *a priori* acceptable for storage at the national SNF repository. The metal reactivity, the generation of hydrogen, and the creation of fine particulate may not meet the waste acceptance requirements as currently stated in draft form. Therefore consequence analyses are under way at the national level to better define the energetic reactions and particulate releases from breached canisters containing metal fuel. It is the improved input to these calculations that is desired. The increased understanding may also improve the confidence in decisions made in future years on the necessity to vent or repackage the fuel.

Schedule Requirements:

Earliest Date Required: (06/2002)

Latest Date Required: (01/2005)

Schedule should be early enough to influence the acceptance and licensing decisions for metal fuel at the national SNF repository.

Problem Description: Thermogravimetric Analysis (TGA) data has been obtained on metal fuel samples at Hanford. These data include information acquired in dry air, moist air and moist helium atmospheres. Although the data mostly confirm literature trends, the number of samples has been small. Furthermore the data taken in dry air have raised the possibility of some increase in oxidation rate at low temperatures. The TGA tests have also shown the propensity of samples to crumble in moist atmospheres (and thereby imply an increased particulate inventory for stored canisters and an increased surface area for further reactions). Recent studies of hydride reactions in fuels at other DOE sites have only been performed on samples with hydride inventories significantly greater than would be anticipated for corroded Hanford fuels.

Calculations sponsored by the National SNF Program are in progress to define the consequences (radionuclide releases) of a breached canister such as those containing Hanford metal fuel. The calculated releases are a function of, among other things, the amount and size of the particulate in a fuel canister and of the oxidation rates (with attributed heat release) for both metal and hydride. More accurate definition of the oxidation rates and particulate sizes will reduce eventual conservative factors applied to safety calculations and make acceptance at the repository more likely.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD. If the canistered U metal SNF, such as N reactor fuel, can be shipped to the repository without further chemical processing or repackaging then the savings are very significant.

Benefit to the Project Baseline of Filling Need: If the metal fuel SNF in its current configuration is acceptable to the repository, then the Hanford loading and shipping facility will not need to be designed to open canisters or to handle/repackage the fuel (only to place existing canisters in a shipping cask).

Relevant PBS Milestone: N/A

End-User: Canister Storage Building Operations

Contractor Facility/Project Manager: SNF Process Engineering, Jim McClusky, Fluor Hanford (FH), (509) 373-2281, Fax (509) 373-1542, James_K_McClusky@rl.gov.

Site Technical Points-of-Contact: Bruce Makenas, Fluor Hanford (FH), (509) 376-5447, Fax (509) 376-8027, Bruce_J_Makenas@rl.gov; Jim Sloughter, Numatec Hanford Corporation (NHC), (509) 373-0591, Fax (509) 372-1542, James_P_Sloughter@rl.gov

DOE End-User/Representative Point-of-Contact: Steve J. Veitenheimer, DOE-RL, (509) 373-9725, fax (509) 373-9837, Steve_J_Veitenheimer@rl.gov

**CROSSWALK FOR FY 2001/FY 2002
NUCLEAR MATERIALS STABILIZATION
SCIENCE AND TECHNOLOGY NEEDS**

Old (FY01)	New (FY02)	Need Title	Changes in FY 2002 Revision	FY02 PBS No.
TECHNOLOGY NEEDS				
PLUTONIUM FINISHING PLANT (PFP)				
RL-99-004-NM	RL-99-004-NM	Process Optimization – Extension of Plutonium Precipitation Process for Hanford's PFP	Updated	RL-CP03
RL-00-005-NM	RL-00-005-NM	Moisture Measurement on Stabilized Material for 3013 Container Storage	Updated	RL-CP03
RL-00-006-NM	RL-00-006-NM	Long Term Gas Generation Surveillance	Updated	RL-CP03
RL-00-010-NM	RL-00-010-NM	Remote Sludge Removal Methods for the Plutonium Reclamation Facility Canyon Floor	Updated	RL-CP03
RL-00-011-NM		Furnace Time Cycle Improvement - Plutonium Finishing Plant	Deleted. Need satisfied	
RL-01-012-NM	RL-01-012-NM	Personal Protective Equipment for Dose Reduction During Special Nuclear Material (SNM) Handling	Updated	RL-CP03
RL-01-013-NM		In-Line Plutonium Concentration Measurement for Mg(OH) ₂ Precipitation Filtrate	Deleted	
RL-01-014-NM	RL-01-014-NM	Chloride Wash Process to Pretreat Feed to Thermal Stabilization	Updated	RL-CP03
RL-01-015-NM	RL-01-015-NM	Improved Throughput Instrumentation for NDA of SNM Items	Updated	RL-CP03
RL-01-016-NM	RL-01-016-NM	Ability to NDA Large Burial Boxes and Long Pipe Sections with Low Plutonium Concentrations	Updated	RL-CP03
RL-01-017-NM	RL-01-017-NM	More Accurate, Quicker NDA of Gloveboxes and HVAC for Plutonium Holdup	Updated	RL-CP03
RL-01-018-NM	RL-01-018-NM	Small-Sample Calorimetry Capabilities	Updated	RL-CP03
RL-01-019-NM		Ability to Open Pressurized 3013 Containers	Deleted. Need satisfied	
RL-01-020-NM	RL-01-020-NM	Item Transfer Method to Replace Current Sealout Techniques	Updated	RL-CP03
RL-01-021-NM		Stabilization and Disposal of Hanford Site Laboratory Solutions as an Alternative to Existing Practice, Including Disposal in Waste Tanks	Deleted	
	RL-02-022-NM	Remediation Method for Tank 241-Z-361 Sludge	New	RL-CP03
	RL-02-023-NM	Surveillance of Gas Pressurization during Transportation and Storage	New	RL-CP03

Old (FY01)	New (FY02)	Need Title	Changes in FY 2002 Revision	FY02 PBS No.
	RL-02-024-NM	Intermediate and Long-Term Surveillance of Safeguards Functions	New	RL-CP03
	RL-02-025-NM	Hydrogen Sensor System for Transportation and Storage Containers	New	RL-CP03
SPENT NUCLEAR FUEL PROJECT				
RL-SNF08	RL-SNF08	CSB Storage Vault Inspection	Updated	RL-RS03
RL-SNF09	RL-SNF09	Improved Multi-Canister Overpack (MCO) Gas Sampling System	Updated	RL-RS03
RL-SNF10	RL-SNF10	Multi-Canister Overpack (MCO) Interrogation Method	Updated	RL-RS03
	RL-SNF14	Sludge Storage and Monitoring System	New	RL-RS03
	RL-SNF15	SNF Drying Technology	New	RL-RS03
WESF				
RL-DD01	RL-DD01	Cs/Sr Capsule Leak Detection System	Updated	RL-CP02
RL-DD041	RL-DD041	Capsule Integrity Assessment Method for WESF	Updated	RL-CP02
SCIENCE NEEDS				
PLUTONIUM FINISHING PLANT (PFP)				
RL-DD032-S		Measurement of Moisture Content in Plutonium Oxides and Other Materials for the Plutonium Finishing Plant	Deleted	
RL-DD034-S		Thermodynamic Data For Plutonium Nitrate	Deleted	
RL-DD036-S		Modeling Thermodynamic Properties	Deleted	
SPENT NUCLEAR FUEL PROJECT				
RL-SNF13-S	RL-SNF13-S	Oxidation and Hydride Formation in U Metal SNF	Updated	RL-RS03

SUBSURFACE CONTAMINANTS

FY 2002 SCIENCE AND TECHNOLOGY NEEDS STATEMENTS

FY 2002 SUBSURFACE CONTAMINANTS TECHNOLOGY NEEDS INDEX

ID #	NEEDS TITLE	PBS #
REMEDICATION OPTIONS		
RL-SS01	Cost-Effective, In-Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater	RL-CP01
RL-SS03	Improved, Remote, In Situ Detection of Carbon Tetrachloride in Groundwater	RL-CP01
RL-SS04	Cost-Effective, In Situ Remediation of Hexavalent Chromium in Groundwater	RL-CP01
RL-SS06	Improved, Remote, In Situ Detection of Hexavalent Chromium in Groundwater	RL-RC01
RL-SS07	Cost-Effective, In Situ Remediation of Strontium-90 in Groundwater	RL-RC01
RL-SS08	Improved, Real-Time, In-Line Detection of Strontium-90 in Process Water	RL-RC01
RL-SS09	Improved, Remote, In Situ Detection of Strontium-90 in Groundwater	RL-RC01
RL-SS10	Improved Technologies for Detection/Delineation of Burial Ground Contents and Waste Site Boundaries	RL-RC01; RL-RC02; RL-CP01; RL-RS01
RL-SS11	Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone	RL-RC01
RL-SS12	Cost-Effective, In Situ Remediation of Radionuclides in the Vadose Zone	RL-RC01; RL-RC02; RL-CP01
RL-SS13	Improved, Real-Time Field Screening During Excavation for Heavy Metals with emphasis on the Following: Lead, Chromium, Mercury, Arsenic, and Barium	RL-RC01; RL-RC02
RL-SS14	Improved, Real-Time Field Screening During Excavation for Radionuclides with emphasis on the Following: Uranium, Plutonium, Strontium-90, and Technetium-99	RL-RC01; RL-RC02; RL-CP01
RL-SS15	Improved, In Situ Characterization and Monitoring of Soil Contaminated by Heavy Metals and Other Ions	RL-RC01; RL-RC02; RL-CP01
RL-SS16	Improved, In Situ Characterization and Monitoring of Soil Contaminated by Radionuclides	RL-RC01; RL-RC02; RL-CP01
RL-SS17	Long-Life Waste Isolation Surface Barrier	RL-CP01
RL-SS18	Improved Handling and Segregation of TRU Waste (Debris)	RL-CP01; RL-RS01
RL-SS19	Detection, Handling and Treatment of Pyrophoric Materials in Burial Grounds	RL-RC02; RL-RS01
RL-SS20	Improved Methods for Debris Handling and Segregation	RL-RC01; RL-RC02; RL-RS01
RL-SS25	Improved, Cost-Effective Methods for Sub-Surface Access to Support Characterization and Remediation.	RL-SS04; RL-RC01; RL-RC02;

ID #	NEEDS TITLE	PBS #
		RL-CP01; RL-RC01
RL-SS26	Improved Methods for Determining Distribution of Beta Emitting Contaminants in Subsurface Soils	RL-RC01; RL-CP01; RL-SS04
RL-SS47	Cost-Effective, In Situ Remediation of Uranium in Groundwater	RL-CP01
RL-SS48	Remote Handling During Excavation Of TRU And High Dose Materials From Burial Grounds	RL-RS01
RL-SS49	Contamination control during excavation activities	RL-RS01
RL-SS50	Waste segregation and packaging for TRU and high dose rate contaminated material	RL-RS01
VADOSE ZONE		
RL-SS27	Use of Field Data from Representative Sites to Elucidate Controlling Features and Processes for Contaminant Distribution.	RL-SS04
RL-SS28	Understand, Quantify And Develop Descriptions Of Reactions And Interactions Between Contaminants Of Concern And Vadose Zone Sediments	RL-SS04
RL-SS29	Develop descriptions of contaminant flow and transport in the vadose zone	RL-SS04
RL-SS30	Understand And Quantify Water Movement In The Vadose Zone Using Uncontaminated Field Sites	RL-SS04
RL-SS31	Provide Advanced Characterization Tools And Methods To Delineate Contaminant Plumes In The Vadose Zone And Relate Plume Distribution To The Distribution Of Geochemical And Hydrogeological Properties	RL-SS04
GROUNDWATER		
RL-SS32	Understand And Quantify The Relationship Between Contaminant Sources, Vadose Zone Plume Properties And Groundwater Plume Properties At Hydrologic Boundaries With A Focus On The Groundwater-Vadose Zone Interface	RL-SS04
RL-SS33	Provide Means To Delineate Regional Groundwater Plumes In Three Dimensions And Define A Scientific Basis For Addressing Scaling Issues In Hanford Groundwater	RL-SS04
RL-SS34	Understand, Quantify And Develop Descriptions Of Biogeochemical Reactions And Interactions Between Contaminants Of Concern And Aquifer Sediments To Describe Biochemical Reactive Transport	RL-SS04
RL-SS35	Provide Means To Quantify The Flux Of Contaminant Between The Groundwater And The Columbia River	RL-SS04
RIVER		
RL-SS36	Provide Means To Integrate Regional Scale Phenomena Into Assessments Of Contaminant Transport And Impacts Within The Columbia River.	RL-SS04
RL-SS37	Provide Methodology To Relate Information Derived From Sitewide-Scale Groundwater Flow Modeling To The Various Scales Associated With Assessing Impacts In The River Environment.	RL-SS04
RL-SS38	Understand, Quantify And Develop Descriptions Of Transport And Transformation Of Groundwater-Derived Contaminants Of Concern In The River.	RL-SS04

ID #	NEEDS TITLE	PBS #
RL-SS39	Understand And Provide Means To Quantify The Impacts Of River Contamination On Receptors	RL-SS04
INVENTORY		
RL-SS40	Provide A Method To Develop Mass Balance (I.E., Holistic) Inventory Estimates.	RL-SS04
RL-SS42	Provide Method For More Accurate Estimates Of Waste Constituent Release Rates And Modes From Waste	RL-SS04
Risk		
RL-SS43	Improvements to Ecological Risk Assessments and Analysis of Population-level Impacts	RL-SS04
RL-SS44	Improvements to Human Health Risk Assessments	RL-SS04
RL-SS45	Establishing Technical Basis for Socio-Economic Risk Assessments	RL-SS04
RL-SS46	Modeling Risk Knowledge	RL-SS04
SCIENCE NEEDS		
RL-SS23-S	Detection/Distribution of Contaminants – Chemical Speciation and Complexation in Site-Specific Groundwaters	RL-SS04
RL-SS24-S	Detection/Distribution of Contaminants – Chemical Binding on Site-Specific Mineral Surfaces	RL-SS04
RL-SS25-S	Detection/Distribution of Contaminants – Chemical Form and Mobility of Dense Non-Aqueous Phase Liquids in Hanford Subsurface	RL-SS04
RL-SS26-S	Transport of Contaminants – Reaction Rates for Key Contaminant Species and Complexes in Site-Specific Groundwaters	RL-SS04
RL-SS27-S	Transport of Contaminants – Rates of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface	RL-SS04
RL-SS28-S	Transport of Contaminants – Rates of Colloid Formation and Colloidal Transport of Contaminants in Site-Specific Groundwaters	RL-SS04
RL-SS29-S	Transport of Contaminants – Effect of Subsurface Heterogeneities on Chemical Reaction and Transport	RL-SS04
RL-SS30-S	Transport of Contaminants – Remedial Technology for Cs Beneath Waste Tanks	RL-SS04
RL-SS31-S	Remediation – Mathematical Formulations of Chemical Reaction/Material Transport	RL-SS04
RL-SS32-S	Remediation – Reactivity of Organics in the Hanford Subsurface	RL-SS04
RL-SS33-S	Remediation – Interaction of Remedial Processes with Hanford Subsurface	RL-SS04
RL-SS34-S	Remediation – Selectivity for Contaminants in the Hanford Subsurface	RL-SS04
RL-SS35-S	Monitoring of Contaminants – Use of Chemical Surrogates for Contaminants	RL-SS04
RL-SS36-S	Monitoring of Contaminants – Chemical Indicators of Remedial Technology Processes	RL-SS04
RL-SS37-S	Monitoring of Contaminants – Chemical Sensor Principals	RL-SS04

SUBSURFACE CONTAMINANTS

Remediation Options

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF CARBON TETRACHLORIDE IN THE VADOSE ZONE AND GROUNDWATER

Identification No.: RL-SS01

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit (s): 200-ZP-1, 200-PW-1

PBS No.: RL-CP01 (RL-ER08)

Waste Stream: Groundwater (200-ZP-1) (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soils (200-PW-1) (Disposition Map Designation: ER-14 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Cost-effective, In Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

Need/Opportunity Category: Technology Need

Need Description: In situ remediation of carbon tetrachloride (CCl₄) into simpler elements or compounds is needed to meet an overall remediation goal of source reduction and control of groundwater concentrations below regulatory limits at an established compliance boundary. In situ processes need to be more efficient than current baseline operations. Monitored Natural Attenuation (MNA) is considered as potential remedial measure that may address some portion of the contamination. An improved technical basis for quantifying natural attenuation processes of carbon tetrachloride in the Hanford subsurface is needed to support evaluation of MNA. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 9/30/00

Latest Date Required: 9/30/09

Pump and treat operations are ongoing for groundwater. Current operations for pump and treat are scheduled for review in FY05. Soil vapor extraction (SVE) operations are ongoing for the vadose zone. The SVE system is currently being reviewed and further enhancements/requirements are being identified.

An Innovative Technology Remediation Demonstration program is underway to identify potential final remedies.

Problem Description: Operable unit 200-ZP-1 underlies the Z Plant and T Plant Aggregate Areas located in the northern half of the 200 West Area. This operable unit addresses contamination in the groundwater and saturated zone soils. Carbon tetrachloride, the contaminant of concern, extends in groundwater over a 3.5 square mile area. Depth to the water table is 270 feet. The ultimate remediation goal for the CCl₄ plume is to eliminate a sufficient amount of contamination so that the plume concentration will not exceed 5 ppb at the 200 Area plateau boundary. A description of the groundwater plume and potential clean up scenarios is presented in a problem statement entitled "Carbon Tetrachloride Contamination in Groundwater Problem Statement". This problem statement is available at <http://www.bhimerc.com/technology/tech.htm>.

An interim ROD has been issued requiring an interim remedial measure (IRM) to treat the 2000-3000 ppb portion of the carbon tetrachloride plume northwest of Z Plant (excluding the T Plant plume). Contaminated groundwater within this portion of the plume is being pumped from the aquifer, then treated with an air-stripping unit followed by vapor phase granular activated carbon polishing. Initial modeling indicates that pump and treat will need to be expanded significantly and operated over a long time period to meet stated objectives.

Operable unit 200-PW-1 represents the source sites and underlying unsaturated soils in the 200 West Area to which carbon tetrachloride was discharged. Co-contaminants include Pu, Am, and other radionuclides. The 200-PW-1 soil vapor extraction system was an expedited response action that extracts carbon tetrachloride vapor from the vadose zone, and treats the off gas with granular activated carbon. Although this action has successfully removed a large mass of CCl₄, SVE operations generally have reduced efficiency when contaminant removal rates are limited by the time required for contamination to diffuse from less permeable portions of the soil. This appears to be occurring in the 200-PW-1 area because removal efficiencies are declining while as much as 50% of the estimated initial inventory may remain in the soil. It is unlikely that the current SVE can be used to remove a large fraction of the remaining contamination in the vadose zone without significant expansion.

Dense non-aqueous phase liquid (DNAPL) has not been positively identified in the 200 Area, but estimates of initial disposal quantities of CCl₄ indicate that free phase is possible. Therefore, DNAPL detection and potentially treatment in both the vadose zone and aquifer are also concerns.

The Innovative Technology Remediation Demonstration (ITRD) program has been interfacing with Hanford to assist in identifying remediation options for the carbon tetrachloride plume in the 200 West Area. As part of this ITRD project, carbon tetrachloride migration was modeled. The modeling effort suggested that under certain conditions (i.e., selected coefficient values for expected natural attenuation process parameters) it is possible that natural processes can attenuate the plume enough to meet regulatory concentration limit at the defined compliance boundary. Additionally, modeling indicated that characterization or estimation of the mass of carbon tetrachloride source material in the aquifer or that will migrate into the groundwater from the vadose zone in the future needs to be better quantified. A final ITRD project report describing assessment activities, the remediation and characterization technologies reviewed by the ITRD, and recommendations from the project will be completed by December 2001.

Benefit to the Project Baseline of Filling Need: Using the baseline pump-and-treat technology for the plume is projected to require long remediation times with high operational costs. Currently, there is no technology identified that appears to be cost effective in treating the plume. Thus, identifying and implementing a cost effective in situ treatment technology should improve the cost and schedule baseline for the project.

Functional Performance Requirements: Concentration of carbon tetrachloride in groundwater is not to exceed 5 ppb at the defined compliance boundary (approximately 5 km down gradient from the source area). The functional performance requirement for the vadose zone is to enable source reduction of carbon tetrachloride such that the residual contamination will not migrate to groundwater.

Work Breakdown Structure (WBS) No. : 1.4.03.3.1.02.08.17.01 (200-ZP-1);
1.4. 03.3.1.03.02.25.01 (200-PW-1)

TIP No.: TIP 0006

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: In situ remediation could potentially reduce time and cost of the current soil vapor extraction and groundwater pump and treat processes.

Regulatory: : If not addressed, carbon tetrachloride in groundwater may migrate and exceed the Safe Drinking Water Act standard of 5 ppb at compliance wells.

Environmental Safety & Health: Possible exposure to carbon tetrachloride.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$50M. This estimate is based on an assumed savings of 5% of the total Hanford groundwater management life-cycle cost of \$1.2B.

Cultural/Stakeholder Concerns: Stakeholders may be sensitive to introduction of chemicals into the subsurface to accomplish in situ remediation

Other: None

Current Baseline Technology: Contaminated groundwater is being pumped to the surface, then treated with an air-stripping unit followed by vapor phase granular activated carbon polishing.

Soil vapor is being extracted from the vadose zone with collection of carbon tetrachloride on granular activated carbon; the carbon is regenerated off-site.

Cost: Pump and treat IRM budget forecast is \$1.0M for FY02. Costs for complete remediation have not been calculated. However, initial modeling indicates that complete remediation will require a significant expansion of the remediation from the current IRM. Rough estimates for building and operating an expanded pump and treat system range from \$50M to \$70M.

Soil vapor extraction budget forecast is \$0.5M for FY02.

Waste: Spent carbon adsorption material that is regenerated off-site.

How Long It Will Take: Initial modeling indicates complete remediation with pump and treat will take at least 30 years.

End-User: Richland Environmental Restoration Project

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Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REMOTE, IN-SITU DETECTION OF CARBON TETRACHLORIDE IN GROUNDWATER AND THE VADOSE ZONE

Identification No.: RL-SS03

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 200-ZP-1, 200-PW-1

PBS No.: RL-CP01 (RL-ER08)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved, Remote, In-Situ Detection of Carbon Tetrachloride in Groundwater and the Vadose Zone

Need/Opportunity Category: Technology Need

Need Description: A remote in situ monitoring device is needed for both groundwater and vadose zone (soil gas) monitoring. Monitoring carbon tetrachloride by discrete sampling is costly and time consuming. In situ monitoring is needed to reduce the labor-intensive process of sampling, handling, and shipping samples for analysis. Minimizing or eliminating purge water production and associated disposal or treatment requirements is desired. In situ monitoring is also needed for situations where monitoring site access is difficult and costly (e.g., in restricted areas on site), or where conditions may pose safety hazards to samplers. In situ monitoring is expected to be important for performance monitoring of remediation processes. In situ detection as a part of characterization is needed to provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems. In situ monitoring is also needed to support long term monitoring associated with long-term stewardship of the plume. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/30

Groundwater pump and treat and soil vapor extraction systems are presently in operation. An Innovative Technology Remediation Demonstration program is underway to identify potential final remedies. Long-

term monitoring will be required to support either continuation of current remediation technologies or alternate technologies.

Problem Description: The central portion of the Hanford Site where the 200 East and 200 West Areas are located was used for chemical separation of plutonium, processing, and waste management. There are two operable units (200-ZP-1 and 200-PW-1) that have been impacted by carbon tetrachloride disposal. Operable unit 200-ZP-1 underlies the northern half of the 200 West Area. The operable unit addresses contamination in the groundwater and saturated zone soils. Source operable unit 200-PW-1 addresses contaminated unsaturated soils associated with Z Plant operations. Contaminants of concern in the operable units are carbon tetrachloride, chloroform, and trichloroethylene. Carbon tetrachloride concentrations of 2,000 - 3,000 ppb occur in the groundwater plume northwest of the Z Plant. Depth to the water table in this area is about 270 feet. A groundwater pump and treat system is in operation at 200-ZP-1 and a vapor extraction system is in operation at 200-PW-1.

At present, concentrations of carbon tetrachloride in groundwater and in soil gas in the vadose zone are measured by discrete sampling from wells with analysis in analytical laboratories (an on-site laboratory is used for soil vapor analysis). Times for receipt of offsite analytical results vary, but can extend to several weeks. Laboratory analytical work is highly accurate, but time delays and high cost associated with sampling and on-site analysis labor are considered to be significant drawbacks. Sampling and analytical waste generated by current methods are other drawbacks adding cost to the monitoring program. In addition to lowering costs, a new monitoring technology that allows measurements at multiple discrete depths within a well will provide for improved plume characterization, better estimates of contaminant inventory, enhanced understanding of plume migration, and better remediation system design.

Benefit to the Project Baseline of Filling Need: An in situ technology would replace the use of laboratory analytical methods and field sampling. At present, these methods are producing satisfactory analytical results but are time consuming and expensive.

Functional Performance Requirements: The new technology must measure contaminant concentrations in situ in groundwater wells, vadose zone wells or potentially in soil gas drive points. Results must be near real-time or on-demand and output must be transmittable by hardwire or telemetry to standard computer connections for data reduction and processing. In situ carbon tetrachloride detection for groundwater should be sensitive to less than 5 ppb. Carbon tetrachloride detection in the vadose zone soil gas should be sensitive to less than 1 ppmv. In situ detectors must be of robust design and capable of operating for long periods without maintenance in the specified environments. A technology able to make measurements at multiple discrete depths within a well to allow for vertical plume profiling is also desired.

Work Breakdown Structure (WBS) No. : 1.4.03.3.1.02.08.17.01 (200-ZP-1);
1.4. 03.3.1.03.02.25.01 (200-PW-1)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: In situ measurement in extraction, injection or monitoring wells would provide remote monitoring of contaminant concentrations. In situ monitoring may be needed to support cost effective performance monitoring of remediation technologies. Combinations of horizontal and vertical profiling could provide highly accurate isopleths of contaminant concentrations to aid in fate and

transport modeling and construction of remediation systems. In situ monitoring will also negate the present requirement of human samplers to purge wells, collect samples and transport to a laboratory, and dispose of waste.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety & Health: There are no environmental safety and health issues of concern with this technology need.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$3M. This estimate is based on an assumed savings of 30% of the current monitoring cost of \$300K/yr over 30 years.

Cultural/Stakeholder Concerns: In situ monitoring could reduce the “traffic” around monitoring locations situated in or near culturally and environmentally sensitive areas.

Other: None.

Current Baseline Technology: Laboratory analysis (an on-site laboratory is used for soil vapor analysis).

Cost: Based on estimates of \$1500 sample collection cost per well, \$175 per sample analysis cost, and 200 wells sampled once per year, the annual costs for monitoring the CT groundwater plume is approximately \$335K per year. The monitoring duration depends on the final remediation strategy but is likely to last for 30 years or more. Although there are no current baseline plans to fund extensive plume mapping, advanced characterization techniques that allowed near real time monitoring of plume concentration changes would be supported by the groundwater project.

Cost per unit: \$1500 sample collection cost per well, \$175 per sample analysis.

Waste: None.

How Long It Will Take: Likely 30 years or more

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Jared D. Isaacs, BHL, (509) 372-9162; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF HEXAVALENT CHROMIUM IN GROUNDWATER

Identification No.: RL-SS04

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100-HR-3, 100-KR-4

PBS No.: RL-RC01 (RL-ER08)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Cost-Effective, In Situ Remediation of Hexavalent Chromium in Groundwater

Need/Opportunity Category: Technology Opportunity

Need Description: Cost-effective, environmentally safe and compliant in situ remediation of hexavalent chromium to reduce the risk to aquatic organisms in the Columbia River. In particular, a technology that can cost effectively treat the large dispersed area of the chromium plumes along the river is needed. (Also see Science needs RL-SS33-S, RL-SS334-S, and RL-SS36-S).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/09

The In Situ Redox Manipulation Technology has been applied at one of the plume hot spots. Pump and treat operations at other plume locations are ongoing. Current operations for pump and treat are scheduled for review in FY05.

Problem Description: The 100-H and 100-K Areas are located along the horn of the Columbia River, in the northern portion of the Hanford Site, and include three nuclear reactors previously used for plutonium production. Primary sources of contamination in groundwater are cribs, french drains, trenches, ponds, retention basins, pipelines, and waste disposal sites. Groundwater in the 100 Area ultimately discharges into the Columbia River. The principal contaminant is chromium, which occurs in two main plumes. The areal extent of the north plume is about 2,000' x 4,000' and the south plume is about 2,000' x 2,000'.

Both plumes have an average thickness of about 15 feet with concentrations ranging from 60 to 600 ppb. Depth to the water table is 85 feet. A description of the groundwater plume and potential clean up scenarios is presented in a problem statement entitled "Hexavalent Chromium Contamination in Groundwater Problem Statement." This problem statement is available at <http://www.bhimerc.com/technology/tech.htm>.

Hexavalent chromium has been identified as a contaminant of concern for aquatic organisms in the Columbia River. A Focused Feasibility Study/Proposed Plan (August 1995) recommended a pump and treat Interim Remedial Measure to address chromate migration from groundwater to the river. An interim ROD (April 1996) for the operable units 100-HR-3 and 100-KR-4 specified installation of a pump-and-treat systems in operable units 100-HR-3 and 100-KR-4 to intercept chromate plumes that impact the Columbia River. The objective of the Interim Remedial Measure (IRM) is protection of aquatic organisms in the river substrate from exposure to hexavalent chromium.

The In Situ Redox Manipulation barrier technology was deployed to remediate one high concentration portion of the chromium plumes. The technology injects dithionite into the aquifer to modify the oxidation/reduction potential of the aquifer and immobilize the chromium. Although the ISRM and the pump-and-treat IRM have been shown to be effective in the more concentrated portions of the plumes, technologies that can cost effectively treat the large dispersed area of the chromium plumes are still required to completely and permanently reduce groundwater concentrations to the required levels.

Chromium treatment in the vadose zone is a related need. (See also Need Title: *Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone.*)

Benefit to the Project Baseline of Filling Need: Using the baseline pump-and-treat technology for the dilute portion of the plume is projected to require long remediation times with high operational costs. Thus, identifying and implementing a cost effective in situ treatment technology should improve the cost and schedule baseline for the project.

Functional Performance Requirements: 40 CFR 141 drinking water standard of 100 ppb; Clean Water Act Ambient Water Quality Criteria of 11 µg/L measured in the pore spaces of sediment in the Columbia River. Any technique implemented to obtain above concentration goal shall not leave any toxic, ecologically damaging or dangerous residue or result in any other type of environmentally undesirable legacy. Techniques that enable treatment along the river boundary where emplacement of the treatment is minimally intrusive over long distances is desired.

Work Breakdown Structure (WBS) No. : 1.4.03.1.1.04.08.08.03 (100-HR-3);
1.4.03.1.1.06.08.06.04 (100-KR-4)

TIP No.: TIP 0005

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: Testing has shown that hexavalent chromium is migrating to the Columbia River in sufficient concentration to pose a risk to aquatic organisms; in situ treatment will negate the requirement and current process of groundwater extraction and ex situ treatment to remove hexavalent chromium (in chromate form).

Regulatory: Federal Clean Water Act Ambient Water Quality Criteria of 11 µg/L; 40 CFR 141 drinking water standard of 100 ppb.

Environmental Safety & Health: Possible worker safety issues regarding handling of reducing chemicals, etc., although proper safety protocols should mitigate these concerns.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$50M. This estimate is based on an assumed savings of 5% of the total Hanford groundwater management life-cycle cost of \$1.2B.

Cultural/Stakeholder Concerns: Stakeholders are sensitive to introduction of chemicals into the vadose zone and groundwater to accomplish in situ hexavalent chromium remediation. Ecotoxicity and bio-uptake are also stakeholder concerns. Disturbance of sensitive cultural areas is also a potential concern that might limit access to the surface areas above the contaminated plumes.

Other: None.

Current Baseline Technology: Extraction of groundwater and ex situ ion exchange treatment.

Cost: Combined Budget for pump and treat IRMs at 100-HR-3 and 100-KR-4 is about \$4.0M in FY02.

Waste: Spent ion exchange resin disposed on site.

How Long It Will Take: Pump and treat operations are scheduled beyond FY02

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Jared D. Isaacs, BHL, (509) 372-9162; Michael J. Truex, PNNL, (509) 376-5461

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DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REMOTE, IN-SITU DETECTION OF HEXAVALENT CHROMIUM IN GROUND WATER

Identification No.: RL-SS06

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100-HR-3, 100-KR-4

PBS No.: RL-RC01 (RL-ER08)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved, Remote, In-Situ Detection of Hexavalent Chromium in Groundwater

Need/Opportunity Category: Technology Need

Need Description: Monitoring hexavalent chromium by discrete sampling is costly and time consuming. In situ monitoring is needed to reduce the labor-intensive process of sampling, handling, and shipping samples for analysis. Minimization or elimination of purge water production and associated disposal or treatment requirements is desired. In situ monitoring is also needed for situations where monitoring site access is difficult and costly, or where conditions may pose safety hazards to samplers. In situ measurement in extraction, injection or monitoring wells, well points, or in river substrate is needed to provide remote monitoring of contaminant concentrations. It is anticipated that in situ monitoring will be needed to support cost effective performance monitoring of plume remediation. In situ detection as a part of characterization is needed to provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems. In situ monitoring is also needed to support long term monitoring associated with long-term stewardship of the plume. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/30

Pump and treat operations are ongoing. The In Situ Redox Manipulation technology was deployed in FY99 in a high concentration area of one of the chromium plumes. Long-term monitoring will be required to support either pump and treat continuation or alternate technologies.

Problem Description: The 100-H and 100-K Areas are located along the horn of the Columbia River, in the northern portion of the Hanford Site, and includes three nuclear reactors previously used for plutonium production. Primary sources of contamination in groundwater are cribs, french drains, trenches, ponds, retention basins, pipelines, and waste disposal sites. Groundwater in the 100 Area ultimately discharges into the Columbia River. The principal contaminant is chromium. Depth to the water table in these areas is approximately 85 feet. To mitigate this contamination, interim remedial measures were initiated at operable units 100-KR-4, and 100-HR-3.

At present, concentrations of chromium are measured by discrete sampling from wells or river substrate with analysis in analytical laboratories. Time for receipt of analytical results varies, but can extend to several weeks. Laboratory analytical work is highly accurate, but time delays and high cost associated with sampling labor are considered to be significant drawbacks. In addition to lowering costs, a new monitoring technology that allows measurements at multiple discrete depths within a well will provide for improved plume characterization, better estimates of contaminant inventory, enhanced understanding of plume migration and better remediation system design.

Benefit to the Project Baseline of Filling Need: An in situ technology would replace the use of laboratory analytical methods and field sampling. At present, these methods are producing satisfactory analytical results but are time consuming and expensive.

Functional Performance Requirements: The new technology must measure contaminant concentrations in situ in extraction, injection or monitoring wells, well points, or in river substrate. Results must be near real-time or on-demand and output must be transmittable by hardwire or telemetry to standard computer connections for data reduction and processing. In situ chromium detection must be sensitive to less than 11 µg/L. In situ detectors must be of robust design and capable of operating for long periods without maintenance in the specified environments. A technology able to make measurements at multiple discrete depths within a well to allow for vertical plume profiling is also desired.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1.04.08.08.03 (100-HR-3);
1.4.03.1.1.06.08.06.04 (100-KR-4)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: In situ measurement in extraction, injection or monitoring wells, well points, or in river substrate would provide real-time monitoring of contaminant concentrations. Combinations of horizontal and vertical profiling could provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems. In situ monitoring will also negate the present requirement of human samplers to purge wells, collect samples and transport to a certified laboratory, and dispose of waste.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety & Health: There are no environmental safety and health issues of concern with this technology need.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$1M. This estimate is based on an assumed savings of 30% of the current monitoring cost of \$100K/yr over 30 years.

Cultural/Stakeholder Concerns: In situ monitoring could reduce the “traffic” around monitoring locations situated in or near culturally and environmentally sensitive areas.

Other: None.

Current Baseline Technology: Laboratory analysis

Cost: Based on estimates of \$1500 sample collection cost per well, \$90 per sample analysis cost, and 71 wells sampled once per year, the annual costs for monitoring the Cr plume is approximately \$113K per year. The monitoring duration depends on the final remediation strategy but is likely to last for over 5 years. Although there are no current baseline plans to fund extensive plume mapping, advanced characterization techniques that allowed near real time monitoring of plume concentration changes would be supported by the groundwater project.

Waste: None.

How Long It Will Take: Beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Jared D. Isaacs, BHL, (509) 372-9162; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF STRONTIUM-90 IN GROUNDWATER

Identification No.: RL-SS07

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100-NR-2

PBS No.: RL-RC01 (RL-ER08)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Cost Effective, In Situ Remediation of Strontium-90 in Groundwater

Need/Opportunity Category: Technology Need

Need Description: Remediation of soluble strontium-90 in the groundwater is needed to reduce risk to human health and the environment. Monitored Natural Attenuation (MNA) is considered as potential remedial measure that may address some portion of the contamination. An improved technical basis for quantifying natural attenuation processes of stontium-90 in the Hanford subsurface is needed to support evaluation of MNA. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 9/30/00

Latest Date Required: 9/30/09

Pump and treat operations are ongoing as an expedited action. An interim record of decision (ROD) was issued in 1999 selecting an interim remedy of pump and treat. The interim ROD includes a requirement to evaluate of other technologies by FY04.

Problem Description: The 100-N Area is located near the Columbia River and includes one nuclear reactor previously used for plutonium production. In the 100-NR-2 operable unit, the primary sources of contamination are ditches and cribs. Groundwater in the 100 Area ultimately discharges to the Columbia River. The principal contaminant, strontium-90 (half-life 29.3 years), is present in groundwater at activities up to 6000 pCi/L. Maximum concentrations of the plume range from 4,000-6,000 pCi per liter

with depth to the water table of 70-80 feet at the source. Plume thickness ranges from 13 to 40 feet. The estimated total inventory of contaminant in both the groundwater and soils ranges from 75 to 89 curies.

The immediate objective is to prevent further migration of Sr-90 into the Columbia River. The long-term objective is to reduce Sr-90 levels to below drinking water standards. An existing pump & treat expedited response action (ERA) has been implemented to help reduce the flux of Sr-90 to the river. The low mobility of the strontium-90 reduces the removal effectiveness to the point that natural radioactive decay removes the contamination almost as fast as the pump and treat operation combined with radioactive decay. Thus, the main purpose of the pump and treat system is for containment while natural decay reduces the source. If containment must be maintained until the highest concentrations in the plume (6,000 pCi/liter) decay to the Safe Drinking Water Act Standard of 8 pCi/liter, the aquifer will need to be contained for 280 years.

A stated desire of the Hanford Advisory Board is to develop technologies to remove strontium-90 in the groundwater near the river with an in situ process like soil flushing. There is a strong preference towards contaminant removal. An important consideration with any contaminant removal process is to assure complete capture of any mobilized contaminant. Although this is a stated desire, other containment and immobilization strategies are still being considered if removal proves to be impractical.

This problem is currently being assessed using the Innovative Treatment Remediation Demonstration (ITRD) process. As part of the ITRD project, the migration of the Sr-90 plume was modeled to assess the potential for movement of Sr-90 into the river. Additionally, a screening-level assessment of applying Monitored Natural Attenuation for the plume was prepared. A final ITRD project report describing assessment activities, the remediation and characterization technologies reviewed by the ITRD, and recommendations from the project will be completed by December 2001.

Benefit to the Project Baseline of Filling Need: Using the baseline pump-and-treat technology for the plume is projected to require long remediation times with high operational costs. Currently, there is no technology identified that appears to be cost effective in treating the plume. Thus, identifying and implementing a cost effective in situ treatment technology should improve the cost and schedule baseline for the project.

Functional Performance Requirements: Reduce strontium-90 activity to the Safe Drinking Water Act criteria of 8 pCi/L for any water entering the Columbia River.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1.07.08.09.02

TIP No.: TIP 0004

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: Remediation of strontium-90 in the groundwater is presently in progress at 100-N Area via pump and treat. Pump and treat has been ineffective due to difficulty in extracting Sr-90 from the aquifer. An in situ remediation process will negate the need for extraction and ex situ treatment.

Regulatory: Strontium-90 in groundwater exceeds the Safe Drinking Water Act standard of 8 pCi/L.

Environmental Safety & Health: Possible exposure to strontium-90

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$50M. This estimate is based on an assumed savings of 5% of the total Hanford groundwater management life-cycle cost of \$1.2B.

Cultural/Stakeholder Concerns: Stakeholders may not accept immobilization or precipitation methods that do not actually remove strontium-90 from the aquifer.

Other: None.

Current Baseline Technology: Extraction of groundwater and ex situ treatment with zeolite. Clean process water is reinjected into the aquifer.

Cost: Budget for pump and treat at 100-NR-2 is about \$0.6M in FY01. Cost estimates for out years have not been completed.

Waste: Spent zeolite disposed on site.

How Long It Will Take: Interim remediation measures have commenced and will continue for several years or until alternate treatment strategies/technologies are approved.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Jared D. Isaacs, BHL, (509) 372-9162; Michael J. Truex, PNNL, (509) 376-5461

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-LINE DETECTION OF STRONTIUM-90 IN PROCESS WATER

Identification No.: RL-SS08

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100-NR-2

PBS No.: RL-RC01 (RL-ER08)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

- ☐ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved, Real-Time, In-Line Detection of Strontium-90 in Process Water

Need/Opportunity Category: Technology Opportunity

Need Description: Monitoring strontium-90 by discrete sampling is costly and slow. In-line sampling with real-time monitoring of contaminant concentrations may support the construction of fully automated treatment systems that could reduce operating costs.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/09

Pump and treat operations are ongoing as an expedited action. An interim record of decision (ROD) was issued in 1999 selecting an interim remedy. The interim ROD includes a requirement to evaluate other technologies by FY04.

Problem Description: The 100-N Area is located along the horn of the Columbia River in the northern portion of the Hanford Site and includes one nuclear reactor previously used for plutonium production.

The primary sources of contamination in the 100-NR-2 operable unit are cribs. Groundwater in the 100 Area ultimately discharges to the Columbia River. The principal contaminant is strontium. Activity of strontium-90 (half-life 29.3 years) in groundwater is up to 6000 pCi/L.

At present, concentrations of strontium-90 are measured by discrete sampling and analysis in field laboratories. These methods require approximately 24 hours for turn around. In general, laboratory analytical work is highly accurate, but time delays and high cost are considered to be significant drawbacks. In-line monitoring would lower the analytical chemistry cost of the pump and treat projects and would support design changes to allow fully automated operation of the ion exchange treatment systems.

Benefit to the Project Baseline of Filling Need: An on-line instrument may reduce the overall operating costs of the pump-and-treat system.

Functional Performance Requirements: The new technology must measure contaminant concentrations as process water passes through pipes at the in fluent and/or effluent ends of treatment processes. Results must be real-time and output must be transmittable through standard computer connections. In-line strontium-90 detection must be sensitive to concentrations on the order of 5-50 pCi/L to support 90% removal rate requirements. The technology must also be cost effective compared to the current discrete sampling approach.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1.07.08.09.02

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: In-line sampling with real-time monitoring of contaminant concentrations may support the construction of fully automated treatment systems that would not require the continued presence of human operators, thus potentially reducing operating costs. In addition, closer monitoring of contaminant concentrations in the process streams would allow operators to accurately identify contaminant breakthrough of lead columns in the treatment systems. This increased efficiency could ultimately reduce the amount of ion exchange resin used, saving money.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety & Health: There are no environmental safety and health issues of concern with this technology need.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200K. This estimate is based on an assumed savings of \$20K/yr over 10 years.

Cultural/Stakeholder Concerns: There are serious stakeholder concerns that detection limits above the regulatory standard may not be protective of aquatic organisms.

Other: None.

Current Baseline Technology: Laboratory analysis.

Cost: Pump and treat sampling costs for strontium are less than \$50K per year.

Waste: None.

How Long It Will Take: Operations scheduled beyond FY00.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; Michael J. Truex, PNNL, (509) 376-5461

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REMOTE, IN-SITU DETECTION OF STRONTIUM-90 IN GROUNDWATER

Identification No.: RL-SS09

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100-NR-2

PBS No.: RL-RC01 (RL-ER08)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Improved, Remote, In-Situ Detection of Strontium-90 in Groundwater

Need/Opportunity Category: Technology Need

Need Description: Monitoring strontium-90 by discrete sampling is costly and time consuming. In situ monitoring is needed to reduce the labor-intensive process of sampling, handling, and shipping samples for analysis. Minimization or elimination of purge water production and associated disposal or treatment requirements is desired. In situ monitoring is also needed for situations where monitoring site access is difficult and costly, or where conditions may pose safety hazards to samplers. In situ measurement in extraction, injection or monitoring wells, well points, or in river substrate is needed to provide remote monitoring of contaminant concentrations. It is anticipated that in situ monitoring will be needed to support cost effective performance monitoring of plume remediation. In situ detection as a part of characterization is needed to provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems. In situ monitoring is also needed to support long term monitoring associated with long-term stewardship of the plume.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/30

Pump and treat operations are ongoing as an expedited action. An interim record of decision (ROD) was issued in 1999 selecting an interim remedy. The interim ROD includes a requirement to evaluate other technologies by FY04. Long-term monitoring will be required to support either pump and treat continuation or alternate technologies.

Problem Description: The 100-N Area is located along the horn of the Columbia River in the northern portion of the Hanford Site and includes one nuclear reactor previously used for plutonium production. Maximum groundwater concentrations range from 4,000 - 6,000 pCi per liter. Depth to water table ranges from 60-80 feet at the source.

At present, concentrations of strontium-90 are measured by discrete sampling from wells or river substrate with analysis in analytical laboratories. Times for receipt of analytical results vary, but can extend to several weeks. Laboratory analytical work is highly accurate, but time delays and high cost associated with sampling labor are considered to be significant drawbacks. In addition to lowering costs, a new monitoring technology that allows measurements at multiple discreet depths within a well will provide for improved plume characterization, better estimates of contaminant inventory, enhanced understanding of plume migration and better remediation system design.

Benefit to the Project Baseline of Filling Need: An in situ technology would replace the use of laboratory analytical methods and field sampling. At present, these methods are producing satisfactory analytical results but are time consuming and expensive.

Functional Performance Requirements: The new technology must measure contaminant concentrations in situ in extraction, injection or monitoring wells, well points, or in river substrate. Depth to water table is 60-80 feet with maximum ground water concentrations ranging from 4,000 - 6,000 pCi per liter. Results must be near real-time or on-demand and output must be transmittable by hardwire or telemetry to standard computer connections for data reduction and processing. In situ strontium-90 detection must be sensitive to less than 8 pCi/L. In situ detectors must be of robust design and capable of operating for long periods without maintenance in the specified environments. A technology able to make measurements at multiple discreet depths within a well to allow for vertical plume profiling is also desired.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1.07.08.09.02

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-029

Justification For Need:

Technical: In situ measurement in extraction, injection or monitoring wells, well points, or in river substrate would provide real-time monitoring of contaminant concentrations. Combinations of horizontal and vertical profiling could provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems. In situ monitoring will also negate the present requirement of human samplers to purge wells, collect samples and transport to a certified laboratory, and dispose of waste.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety & Health: There is no environmental safety and health issues of concern with this technology need.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

The estimated life-cycle cost savings associated with filling this need is \$2M. This estimate is based on an assumed savings of 30% of the current monitoring cost of \$250K/yr over 30 years.

Cultural/Stakeholder Concerns: In situ monitoring could reduce the “traffic” around monitoring locations situated in or near culturally and environmentally sensitive areas.

Current Baseline Technology: Laboratory analysis.

Cost: Based on estimates of \$1500 sample collection cost per well, \$150 per sample analysis cost, and 146 wells sampled once per year, the annual costs for monitoring the Sr plume is approximately \$240K per year. The monitoring duration depends on the final remediation strategy but may last for 280 years or more. Although there are no current baseline plans to fund extensive plume mapping, advanced characterization techniques that allowed near real time monitoring of plume concentration changes would be supported by the groundwater project.

How Long It Will Take: Beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; Michael J. Truex, PNNL, (509) 376-5461

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED TECHNOLOGIES FOR DETECTION/DELINEATION OF BURIAL GROUND CONTENTS AND WASTE SITE BOUNDARIES

Identification No.: RL-SS10

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): All burial ground sites in the 100, 200, and 300 Areas and liquid waste disposal sites in the 200 Area.

PBS No.: RL-RC01 (RL-ER01), RL-RC02 (RL-ER03), RL-CP01 (RL-ER02), RL-RS01 (RL-ER03)

Waste Stream: Disposition Map Designations: ER-01 [technical risk score 4], ER-02 [technical risk score 4], ER-05 [technical risk score 4], ER-06 [technical risk score 4], ER-08 [technical risk score 4], T3-ER [technical risk score 5]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as a high priority.

Need Title: Improved Technologies for Detection/Delineation of Burial Ground Contents and Waste Site Boundaries.

Need/Opportunity Category: Technology Need

Need Description: Improved technologies are needed for non-intrusive or minimally intrusive methods for identifying burial ground contents and delineating difficult to find waste sites. A large number of burial grounds and liquid waste disposal sites were created during fifty years of defense plutonium production, many of which have been covered with soil (surface stabilized) or have no surface expression. Documentation of materials that were placed in the burial grounds and exact location of some sites is incomplete. To aid in remediation planning, the contents and boundaries of a burial ground need to be determined to the best extent possible prior to excavation. Commercial geophysical techniques include a range of ground penetrating radar, electromagnetic, and magnetometer techniques that are readily available and provide good two-dimensional information about buried objects. However, there are two significant technical gaps in current technology in addition to overall characterization cost issues. These are:

- Improving confidence in correlating geophysical data to the type and properties of buried objects (e.g., identifying contents such as drums)
- Improved vertical resolution of geophysical data (e.g., providing a 3-D image).

Non-intrusive or minimally intrusive methods are also needed to identify geological or buried waste site boundaries prior to characterization/remediation activities for the 200 Area liquid waste sites. A significant number of the 200 Area's liquid waste disposal sites have been interim stabilized prior to characterization or have no discernable surface expression. As a result, 5 to 15 feet of stabilized fill material (either imported fill or material pushed in from the sides of the trenches or ditches) now exists above the original contours of the liquid waste sites. Characterization of these waste sites requires a clear delineation of the original contours. Performing this delineation in a non-intrusive manner is needed.

Specific to the 618-10 and 618-11 burial grounds, methods are needed to delineate the distribution of radioactive contamination, specifically TRU and high dose rate contamination, and chemical contamination (e.g., lead material) associated with debris in the burial ground. Additional information about the contents of the 618-10 and 618-11 burial grounds is available in "Characterization of the 618-11 Solid Waste Burial Ground, Disposed Waste, and Description of the Waste-Generating Facilities" (Waste Management Federal Services, 1998, HNF-EP-0649, Rev. 0).

Future work in the 300 Area Industrial section will require detailed delineation of underground utilities including determining whether utilities found are active or inactive. The technique for utility delineation needs to be applicable within and around operating industrial buildings.

Non-intrusive characterization techniques may also be used to provide characterization data to support long-term stewardship decisions.

Schedule Requirements:

Earliest Date Required: 9/30/01

Latest Date Required: 9/30/13

Burial grounds and liquid waste disposal sites exist in the 100, 200, and 300 Areas. The first burial ground (located in the 300 Area) was partially excavated in FY98. Characterization of the 200 Area waste sites has begun and remediation is expected to extend to 2018.

Problem Description: Fifty years of defense plutonium production resulted in the creation of a large number of waste sites in Hanford's 100, 200, and 300 Areas. The 100 Areas are located along the Columbia River and include nine nuclear reactors previously used for plutonium production. The 300 Area is also located along the Columbia River and contains the fuel fabrication facilities. The 200 Area is located on the central plateau and contains the spent fuel extraction and processing facilities, and the radioactive waste storage tanks. Hanford's burial grounds contain drummed waste and a variety of solid waste debris including construction waste, discarded equipment, and protective clothing. Much of this waste is contaminated with low-level radioactive materials. The baseline for the 100 and 300 area sites is excavation and disposal on site. The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or barrier placement strategies. Non-intrusive or minimally-intrusive investigation and determination of burial ground contents will aid the development of remedial action plans and will reduce exposure to workers involved in removal operations. This enhanced characterization information may potentially be useful in avoiding contract modifications during remediation activities. In addition, these tools may also be necessary to support decisions to leave some burial grounds in place with caps or other measures to control exposures. Improved detection techniques would also allow for hot spot/selective removal alternatives and help locate soil sites covered with clean fill material.

At present, gross burial ground delineation and assessment is accomplished with various remote sensing instruments, including ground penetrating radar, magnetic anomaly detection, and remote roving vehicles to measure gamma ray emissions. Ground penetrating radar is currently being used in the 200 Areas to define buried waste site boundaries prior to characterization, with mixed success. These methods are effective to identify certain types of debris, contaminants, and changes in subsurface conditions. For example, ground-penetrating radar effectively detects physical objects that present a distinctly different reflectivity than the surrounding matrix, such as metal drums or pipes. However, burial ground excavation experience this past year showed that current techniques were not able to conclusively identify large areas of drummed waste in two separate burial grounds. The remote measurement of gamma radiation can identify the presence of certain radionuclides such as cobalt-60 that are high-energy gamma emitters. Other radioactive contaminants, such as strontium-90 and uranium, are beta and alpha particle emitters that cannot be detected with surface remote detection because of the shielding provided by overlying soils.

Benefit to the Project Baseline of Filling Need: Improved pre-excavation characterization techniques may reduce the overall remediation costs and reduce the risks of encountering unexpected material and incurring unexpected costs associated with these materials.

Functional Performance Requirements: Technology must be a remote-sensing design capable of non-intrusive or minimally-intrusive methods for physical or radiological identification of burial ground contents. Sensing of different soil characteristics (which can be subtle) and features of liquid waste disposal sites waste site contours are also required. Some items may be located as deep as 50 ft from the surface but much of the buried waste at Hanford is at depths of less than 15 feet. High resolution, real-time imaging systems would be useful to support excavation or characterization planning. Physical determination of objects should be sensitive enough to accurately determine the presence of drummed waste and also differentiate small items, such as pipes, bricks, machinery, etc. While several technologies are available to detect different types of features in the subsurface, ways to integrate the geophysical data from these various technologies are also needed. Radiological sensing should be directed toward segregation of transuranic debris from non-transuranic debris and identification of other radionuclides if possible. The 618-10 and 618-11 burial grounds contain specific types of waste forms that will require identification of TRU material. These burial grounds received high-level, low-level, and TRU waste. Some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in the vertical pipe units and caissons. Waste materials in vertical pipe units and caissons may be packed inside cans of various sizes (e.g., 1-L, 19-L, 57-L [quart, 5-gallon, 15 gallon]). Some TRU waste was encased in concrete for disposal to burial ground trenches. Radioactive isotopes in these burial grounds may include ^{14}C , ^{60}Co , ^{65}Zn , ^{90}Sr , ^{103}Ru , ^{131}I , ^{137}Cs , ^{144}Ce , ^{147}Pm , ^{226}Ra , ^{232}Th , ^{233}U , ^{235}U , ^{237}Np , ^{238}U , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Am , and ^{244}Cm .

Utility delineation is needed for power, communication, sewer, and water utilities. Determination of active versus inactive status for utilities is also needed. The primary area requiring utility delineation is the 300 Area industrial section.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01); 1.4.03.2.1 (RL-RS01)

TIP No.: TIP 0001, TIP 0002, TIP 0003

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028, M-15-00, M-16-00

Justification For Need:

Technical: Enhanced detection and delineation methods could provide accurate information for characterization and remedial action planning.

Regulatory: There is no regulatory requirement for this technology.

Environmental Safety & Health: Successful non-invasive, or minimally-invasive, detection and delineation technologies could reduce risk of excavation workers encountering unexpected items that require work stoppages and upgrades in personnel protective equipment.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$30M. This estimate is based on an assumed savings of 5% of the total cost of \$700M to excavate the 100 and 300 Area burial grounds.

Cultural/Stakeholder Concerns: There are concerns that inadequate waste site characterization will be used to support decisions to leave waste in place.

Current Baseline Technology: Ground penetrating radar, electric magnetic induction, trenching, and visual examination.

Cost: Budget forecast for 300 Area burial ground activities is about \$3.1M. Estimates to complete excavation and disposal of all the burial grounds in the 100 and 300 Areas is nearly \$700M. Characterization activities in the 200 Areas are estimated to be \$70M.

Waste: None

How Long It Will Take: Burial ground and soil remediation activities in the 100 and 300 Areas are planned for next ten years. Characterization and remediation activities in the 200 Area will begin in FY00 and are scheduled to continue through 2018.

End-User: Richland Environmental Restoration Project

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF HEXAVALENT CHROMIUM IN THE VADOSE ZONE

Identification No.: RL-SS11

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Selected soil sites in 100 Area

PBS No.: RL-RC01 (RL-ER01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone

Need/Opportunity Category: Technology Need

Need Description: Cost effective in situ remediation technologies are required to remove or immobilize chromium contamination that is believed to exist in the vadose zone at depths below 15 feet. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/06

Soil Remediation is ongoing.

Problem Description: The 100 Area has over 3.9 million cubic yards of soil and debris in 340 contaminated soil sites and 50 buried waste sites that will require remediation. Soil units include cribs, french drains, trenches, ponds, and retention basins that received radiologically and chemically contaminated liquid effluent from reactor and support operations. These areas will be cleaned up to meet residential land-use requirements. The baseline strategy for soil sites is to excavate the top 15 feet of contaminated soil and ship to on site disposal. If contamination extends below 15 feet, soil contaminant concentrations and/or mobility must be low enough to prevent future groundwater problems. If concentrations exceed these levels, additional remedial measures (removal, containment or treatment) may be required.

The main heavy metal that has a high enough mobility to be a concern in soils below 15 feet is chromium. Chromium contamination in the 100-H and 100-K Areas is known to have reached groundwater and resulted in concentrations that require remedial measures. Although the vadose zone source of this contamination has not been positively identified, it is likely that chromium contamination extends deep into the vadose zone where excavation is not practical.

Benefit to the Project Baseline of Filling Need: In situ technologies may be more cost effective for treating deep vadose zone contamination and result in cost in schedule savings for the project baseline.

Functional Performance Requirements: In soils deeper than 15 ft, reduce concentrations or mobility of chromium contamination to the point that remediation goals are met. The remediation goal for Cr (VI) soil concentrations found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17 rev. 2) is 2.0 mg/kg. Remediation goals can be met by reducing soil concentrations to below this level or decreasing the mobility of this contaminant to the point that it will not result in groundwater or surface water concentrations above specified levels.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1 (RL-RC01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026

Justification For Need:

Technical: The groundwater table in the 100 Area is about 85 feet below ground surface. Excavation of contamination in the vadose zone to these depths is impractical.

Regulatory: Soil concentrations currently exceed preliminary remediation goals as defined in various RODs.

Environmental Safety & Health: The contaminants pose a potential risk to human health and the environment.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$50M. This estimate is based on an assumed savings of 5% of the total Hanford groundwater management life-cycle cost of \$1.2B.

Cultural/Stakeholder Concerns: High exposures to remediation workers and potential for off-site releases are a concern. Stakeholders are sensitive to introduction of chemicals into the vadose zone to accomplish in situ remediation. Stakeholders are also concerned that in situ immobilization strategies that reduce human health risk from groundwater pathways may not be fully protective for food chain pathways, particularly under acid conditions.

Other: None.

Current Baseline Technology: Excavate and dispose.

Cost: Estimated cost to excavate and dispose is \$60/ton for surface soils. This cost is primarily based on excavation of soils down to approximately 15 ft below ground surface. Costs of excavation below 15 feet would likely be greater than shallow excavation costs.

Waste: Excavated soil would be disposed on site.

How Long It Will Take: Soil remediation activities in the 100 Areas are planned for the next ten years.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; John April, BHI, (509) 372-9632; Ashur R. Michael, BHI, (509) 372-9074; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen, BHI, (509) 372-9075

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Glenn I. Goldberg, DOE, (509) 376-9552; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST EFFECTIVE, IN SITU REMEDIATION OF RADIONUCLIDES IN THE VADOSE ZONE

Identification No.: RL-SS12

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): All soil sites

PBS No.: RL-RC01 (RL-ER01), RL-RC02 (RL-ER03), RL-CP01 (RL-ER02)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

_____	1. Critical to the success of the ACPC
<u> X </u>	2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
_____	3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

Need Title: Cost Effective, In Situ Remediation of Radionuclides in the Vadose Zone

Need/Opportunity Category: Technology Opportunity

Need Description: Numerous contaminated soil sites exist at the Hanford site as a result of liquid effluent discharge to the soil column. Cost effective in situ remediation technologies are required to deal with radioactive contamination. In situ technologies that are more cost effective than the baseline excavation/disposal costs (\$60/ton) are needed (200 Area) to treat the top 15 feet of soil. In situ treatment technologies may also be required (100, 200, and 300 Areas) if soil contamination extends beyond the 15 feet to depths where excavation costs become prohibitive. Primary radionuclides of concern include uranium, plutonium, cesium, cobalt, strontium-90, and technetium-99. Monitored Natural Attenuation (MNA) is considered as potential remedial measure that may address some portion of the contamination. An improved technical basis for quantifying natural attenuation processes for radionuclides in the vadose zone is needed to support evaluation of MNA. Additionally of concern is remediation of long-lived mobile radionuclides to be protective of groundwater. In some instances, it may also be necessary to remediate TRU waste in situ prior to surface capping of waste sites in the 200 Area. (Also see Science needs RL-SS33-S, RL-SS34-S, and RL-SS36-S)

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Soil Remediation is ongoing. Characterization and remediation of the 200 Area sites began in FY 1999 and will extend to 2018.

Problem Description: Fifty years of defense plutonium production at Hanford resulted in the creation of a large number of contaminated soil sites. The Hanford site is essentially divided into three areas: the 100 Area along the Columbia River where the plutonium production reactors were located, the 300 Area at the south end of the site where fuel fabrication facilities were located and the 200 Area located near the center of the site where the reactor-fuel processing and waste management facilities were located. The approximate total volumes of soil requiring remediation at the Hanford Site (liquid waste disposal sites and burial grounds) are: 3.9 million cubic yards in the 100 Areas, approximately 10 million cubic yards in the 200 Areas, and 0.8 million cubic yards in the 300 Area. Remediation schedules and requirements for these sites differ due to several factors including the types of contaminants present, the location of the area relative to the river, and the potential future land use for each area.

The 300 Area has several soil sites that resulted from liquid disposal in ponds and trenches. These areas will be cleaned up to meet industrial land-use requirements. Uranium is used as an indicator contaminant and soils with concentrations greater than 350 picocuries/gram in the top 15 feet are removed to reduce the risk potential from the direct exposure pathway. The baseline strategy for soil sites is to excavate the top 15 feet of contaminated soil and ship to on site disposal facilities. If contamination extends beyond 15 feet, soil contaminant concentrations and/or mobility must be low enough to prevent future groundwater problems. If concentrations exceed these levels, additional remedial measures (removal, containment or treatment) may be required. In situ treatment technologies may be required if soil contamination extends beyond the 15 feet to depths where excavation costs become prohibitive.

The 100 Area has over 340 contaminated soil sites that are expected to require remediation. Soil waste disposal units including cribs, french drains, trenches, ponds, and retention basins received radiologically and chemically contaminated liquid effluent from reactor and support operations. These areas will be cleaned up to meet residential land-use requirements. The baseline strategy for soil sites is to excavate the top 15 feet of contaminated soil and ship to on site disposal facilities. If contamination extends beyond 15 feet, soil contaminant concentrations and/or mobility must be low enough to prevent future groundwater problems. The main radioactive contaminants of concern in the deep zone are strontium-90, cobalt-60, cesium-137, and nickel-63. If concentrations exceed these levels, additional remedial measures (removal, containment or treatment) may be required. In situ treatment technologies may be required if soil contamination extends beyond the 15 feet to depths where excavation costs become prohibitive.

The 200 Area contains approximately 1000 different soil and burial ground sites. Soil waste sites were predominantly the result of liquid discharge to cribs, ponds and ditches. This area is located furthest from the Columbia River and is scheduled for remediation after the 300 and 100 Areas. This area will probably have an industrial future land use designation. The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or surface barrier placement strategies. The target/indicator contaminants will be developed for the 200 Area as part of the characterization activities. Excavation strategies will generally be similar to the other areas but the depth and target/indicator contaminants have not been identified. However, plutonium, uranium, cesium, cobalt, strontium, and technetium are all likely to be the key indicator contaminants for many of the contaminated sites. In situ technologies that are more cost effective than the baseline excavation/disposal costs (\$60/ton) are needed to treat surface soils. Other potential concerns in the 200 Area include contamination (primarily uranium and technetium) that has migrated deep into the vadose zone (>150 ft) at concentrations that can impact groundwater, and near surface hot spots that prevent the sole use of surface barriers due to inadvertent intruder scenarios. In situ treatment technologies that can treat contamination at depth or treat hot spots to reduce health risks associated with intruder scenarios are required. In situ stabilization of TRU may be required prior to capping some waste sites in the 200 area. In situ vitrification is the current technique under consideration for TRU stabilization.

Benefit to the Project Baseline of Filling Need: Use of in situ technologies may enable remediation approaches that could save cost and schedule for the project baseline.

Functional Performance Requirements: Reduce concentrations or mobility of radioactive contaminants to the point that remediation goals are met. The following remediation goals for contamination deeper than 15 ft can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17 rev. 2): U-233/234, 1.1 pCi/g; U-235, 1.0 pCi/g; U-238, 1.1 pCi/g; Pu-238, 1,123 pCi/g; Pu-239/240, 718,600 pCi/g; Sr-90, 4.5 pCi/g and Tc-99, 15 pCi/g. The 200 Area sites do not currently have specific remediation goals, but contaminants of concern include isotopes of uranium, plutonium, cesium, cobalt, strontium, and technetium. Some remediation goals in the 200 Area will likely be linked to a concentration that is protective of groundwater. Treatment requirements for TRU prior to surface capping have not yet been established.

Work Breakdown Structure (WBS) No.: 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, M-16-00

Justification For Need:

Technical: In situ technologies increase treatment flexibility and have the potential to help shorten remediation time periods and reduce costs.

Regulatory: Soil concentrations currently exceed preliminary remediation goals as defined in various RODs.

Environmental Safety & Health: The contaminants pose a potential risk to human health and the environment. Remediation by conventional methods such as excavation may result in exposure to workers. There is also the potential for offsite releases during soil handling operations.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$4M. This estimate is based on an assumed savings of 0.1% of the total 200 Area cost of \$2.8B plus 0.1% of the total 100 Area cost of \$900M.

Cultural/Stakeholder Concerns: High exposures to remediation workers and potential for off-site releases are a concern. Stakeholders are sensitive to introduction of chemicals into the vadose zone to accomplish in situ remediation.

Other: None.

Current Baseline Technology: Excavate and dispose.

Cost: Estimated cost to excavate and dispose is \$60/ton.

Waste: Excavated soil would be disposed in on site disposal facilities.

How Long It Will Take: Soil remediation activities in the 100 and 300 Areas are planned for the next ten years. Soil activities in the 200 Area are scheduled to continue until 2018.

End-User: Richland Environmental Restoration Project

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DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert G. Mcleod, DOE, (509) 372-0096; Glenn I. Goldberg, DOE, (509) 376-9552; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME FIELD SCREENING DURING EXCAVATION FOR HEAVY METALS WITH EMPHASIS ON THE FOLLOWING: LEAD, CHROMIUM, MERCURY, ARSENIC, AND BARIUM

Identification No.: RL-SS13

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Selected soil sites in the 100 and 300 Areas.

PBS No.: RL-RC01 (RL-ER01), RL-RC02 (RL-ER03)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

Need Title: Improved, Real-Time Field Screening During Excavation for Heavy Metals with emphasis on the Following: Lead, Chromium, Mercury, Arsenic, and Barium

Need/Opportunity Category: Technology Opportunity

Need Description: Rapid, field screening techniques are needed to guide remedial excavation and to ensure that excavated materials meet waste acceptance criteria prior to disposal. Primary metal contaminants of concern include lead, chromium, mercury, arsenic, and barium

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/18

Soil Remediation is ongoing. Characterization and remediation of the 200 Area sites has begun and is expected to continue through 2018.

Problem Description: Millions of cubic yards of contaminated soils are slated for excavation and on site disposal. Generally, radioactive contaminants in these soils are the primary drivers for remediation and detection of heavy metals for excavation guidance is not required. However, in some cases, heavy metal contamination exists outside the area of gamma-emitting radioactive contamination and must be detected to guide excavation for closure of a site. Heavy metals are common co-contaminants in these soils and may control the ability to cost effectively dispose of the materials on site. Soils that contain these heavy metal contaminants but do not fail the TCLP test are quickly and cost-effectively disposed. Soils that fail

the TCLP test either require treatment or time consuming treatment variances. If TCLP results were easy to obtain, soils could be segregated into materials requiring additional treatment and those that could be directly disposed. However, the current long turn around time for TCLP analyses has caused operational inefficiencies and higher costs. For example, during excavation of Landfill 1D and Burial Ground 618-4 in the 300 Area, soils contaminated with leachable forms of lead were discovered. Due to TCLP test turnaround times, the soils are excavated, sampled, stockpiled and loaded into disposal transportation containers after TCLP results are obtained. Barium contamination is not as widespread as lead but barium contaminated soils that fail the TCLP test have also been found in the 618-4 burial ground. Other heavy metals that are a potential concern but have not failed TCLP in soils excavated to date include chromium, arsenic, and mercury.

Effective soil screening can be conducted if 20 times the allowable TCLP leachate concentration can be detected in the soil. If the soil concentrations of RCRA metals are below these levels, they cannot fail the TCLP test. Detection techniques that could accurately detect these concentrations within an hour would be an improvement over the current XRF baseline. However, this screening method is conservative because significant concentrations of some hazardous metals are stable in soil matrixes and will not readily leach. A cost-effective test that can predict TCLP results within a few hours would be a better, less conservative soil screening technique. Predictive TCLP tests that reduce the turn around time to two days or less would be a worthwhile improvement to the current long TCLP turnaround time.

Benefit to the Project Baseline of Filling Need: Improved technologies may have cost and schedule savings compared to the current XRF screening technology and slow turnaround TCLP testing.

Functional Performance Requirements: Detection technologies must be portable, easy to use, produce little or no secondary waste and provide near real-time field screening or quick turnaround results that correlate to TCLP results. Detection to levels that would allow for real time worst case Land Disposal Restricted (LDR) determinations (e.g. 20 times Toxic Characteristic Leaching Procedure (TCLP) limits) are required for these metal contaminants. Detection level targets based on soil cleanup goals from the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17 rev. 2): are as follows: lead (10.2 mg/kg), chromium (2.0 mg/kg), mercury (0.33 mg/kg), arsenic (20 mg/kg), and barium (132 mg/kg). Techniques that would allow accelerated (e.g. less than two days) TCLP results are also desired.

Work Breakdown Structure (WBS) No. : 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028

Justification For Need:

Technical: Current technology (XRF technology) can measure high-end concentrations but new technology is needed to accurately measure concentrations at the target levels.

Regulatory: None

Environmental Safety & Health: Rapid screening techniques will reduce worker exposure times and help assure that soils that do not meet LDR are properly managed.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$1M. This estimate is based on an assumed savings of 0.1% of the total cost for the 100 Area of \$900M.

Cultural/Stakeholder Concerns: None.

Current Baseline Technology: XRF and discrete sampling.

Cost: Cost of equipment and analyses are minimal but hidden costs related to reduced excavation efficiency could be substantial.

Cost per unit: Not determined.

Waste: Laboratory waste generated from discrete sampling.

How Long It Will Take: Soil remediation activities will extend to 2018 in the 200 Area.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; John April, BHL, (509) 372-9632; Ashur R. Michael, BHL, (509) 372-9074; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHL, (509) 372-9075; Michael J. Graham (200 Area), BHL (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Robert G. Mcleod, DOE, (509) 372-0096; Glenn I. Goldberg, DOE, (509) 376-9552; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME SCREENING DURING EXCAVATION FOR RADIONUCLIDES WITH EMPHASIS ON THE FOLLOWING: URANIUM, PLUTONIUM, STRONTIUM-90, AND TECHNETIUM-99

Identification No.: RL-SS14

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): All soil sites

PBS No.: RL-RC01 (RL-ER01), RL-RC02 (EL-ER03), RL-CP01 (RL-ER02)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

Need Title: Improved, Real-Time Field Screening During Excavation for Radionuclides with emphasis on the Following: uranium, plutonium, strontium-90, and technetium-99

Need/Opportunity Category: Technology Need

Need Description: Rapid, field screening techniques are needed to direct characterization, excavation operations, and release of material for transport to disposal. Field screening techniques for characterization and delineation will assure that high cost, site characterization laboratory analyses are optimized. These techniques will also help assure that operations at excavation sites remove all contaminated material and that excavated materials meet waste acceptance criteria prior to disposal. Primary radioactive contaminants requiring improved field detection sensitivities include uranium, plutonium, strontium-90 and technetium-99. In some instances, nickel-63 detection requires improved sensitivity.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/18

Soil Remediation is ongoing. Characterization and remediation of the 200 Area sites has begun and is expected to continue through 2018.

Problem Description: The approximate total volumes of soil requiring remediation at the Hanford Site (liquid waste disposal sites and burial grounds) are: 3.9 million cubic yards in the 100 Areas,

approximately 10 million cubic yards in the 200 Areas, and 0.8 million cubic yards in the 300 Area. The 100 Area has over 340 contaminated soil sites that are expected to require remediation. Soil units include cribs, french drains, trenches, ponds, and retention basins that received radiologically and chemically contaminated liquid effluent from reactor and support operations. Strontium-90 is a primary radioactive contaminant of concern. The 200 Area contains approximately 1000 different soil and burial ground sites. Soil waste sites are predominantly the result of liquid discharges to cribs, ponds and ditches. The 200 Area remediation include a combination of removal and leave in-place with in situ treatment and/or barrier placement strategies. The target/indicator contaminants will be developed for the 200 Area as part of the characterization activities. However, plutonium, uranium, and strontium are likely to be the key indicator contaminants for many of the contaminated sites. Technetium may be an important contaminant and is currently difficult to detect at the desired levels.

The boundaries for some of these liquid waste disposal sites are poorly defined. Also, other sites may have significantly different contaminant concentrations throughout the site. The baseline strategy for soil sites in the 100 Area is to excavate the top 15 feet of contaminated soil and dispose on site. Portions of the 200 area sites are also anticipated to be excavated and disposed on site. Rapid field screening techniques are required to help direct excavation operations so that all soils contaminated above required levels can be removed. Field screening techniques that support characterization and delineation will also assure that high cost, site characterization laboratory analyses are optimized.

Benefit to the Project Baseline of Filling Need: Improved technologies may have cost and schedule savings compared to the current baseline gamma detectors and discrete sampling.

Functional Performance Requirements: Detection technologies must be portable, easy to use, produce little or no secondary waste and provide real-time field screening. Detection levels must be comparable to cleanup requirements. The following remediation goals can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17 rev. 2): Ni-63, 4,026 pCi/g; U-233/234, 1.1 pCi/g; U-235, 1.0 pCi/g; U-238, 1.1 pCi/g; Pu-238, 37.4 pCi/g; Pu-239/240, 33.9 pCi/g; Sr-90, 4.5 pCi/g; and Tc-99, 15 pCi/g. The 200 Area sites do not currently have specific remediation goals. In the 300 area, remediation goals require excavation of soils with greater than 350 pCi/g of total uranium. The detection limit currently required for use in characterization is 50 pCi/g, but a lower detection limit may be needed in the future.

Work Breakdown Structure (WBS) No. : 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028

Justification For Need:

Technical: Current technology can measure high-end concentrations of gamma emitters but new technology is needed to accurately measure the low-end concentrations of alpha and beta emitters.

Regulatory: None.

Environmental Safety and Health: Rapid screening techniques will reduce worker exposure times and help assure that all soil contaminated above regulatory limits is removed and all contaminated sites are located.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$1M. This estimate is based on an assumed savings of 0.1% of the total cost for the 100 Area of \$900M.

Cultural/Stakeholder Concerns: None.

Other: None.

Current Baseline Technology: Gamma detectors and discrete sampling.

Cost: Cost of equipment and analyses to support excavation are minimal but hidden costs related to reduced excavation efficiency could be substantial. Baseline characterization activities in the 200 Areas are estimated to be \$70M.

Cost per unit: Not determined.

Waste: Laboratory waste generated from discrete sampling.

How Long It Will Take: Soil remediation activities in the 100 and 300 Areas are planned for the next ten years. Soil activities in the 200 Area are scheduled to continue through 2018.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; John April, BHI, (509) 372-9632; Curt Wittreich, (509) 372-9586; Ashur R. Michael, BHI, (509) 372-9074; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHI, (509) 372-9075; Michael J. Graham (200 Area), BHI (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert G. Mcleod, DOE, (509) 372-0096; Glenn I. Goldberg, DOE, (509) 376-9552; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, IN SITU CHARACTERIZATION AND MONITORING OF SOIL CONTAMINATED BY HEAVY METALS AND OTHER IONS

Identification No.: RL-SS15

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100, 200, and 300 Areas

PBS No.: RL-RC01 (RL-ER01), RC02 (RL-ER03), RL-CP01 (RL-ER02)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as a high priority.

Need Title: Improved, In Situ Characterization and Monitoring of Soil Contaminated by Heavy Metals and Other Ions

Need/Opportunity Category: Technology Need

Need Description: The extent of contamination in soil and burial ground sites is often poorly defined. A cost-effective technology that provides real-time, in situ measurement of heavy metals (hexavalent chromium, mercury, lead, nitrate, and sodium) at depth is required to better define the contaminant plume boundaries prior to remediation and also to support long-term monitoring for performance validation of the completed remediation activity or to provide monitoring as part of Monitored Natural Attenuation. In situ monitoring is also needed to support long term monitoring associated with long-term stewardship of contaminated soils.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/13

Characterization and remediation of the 200 Area sites began in FY99 and is expected to continue through 2018. Soil Remediation is ongoing in the 100 and 300 Areas, and is expected to be completed before 200

Area remediation. Tank farm characterization is on going with planning for remedial action and closure having started. The first tank farm is scheduled to be closed by 2014.

Problem Description: The approximate total volumes of soil requiring remediation at the Hanford Site (liquid waste disposal sites and burial grounds) are: 3.9 million cubic yards in the 100 Areas, approximately 10 million cubic yards in the 200 Areas, and 0.8 million cubic yards in the 300 Area. Characterization and remediation efforts would be enhanced in all these areas with effective in situ characterization. Specific examples for each area are given below.

A specific near term need for in situ chromium detection exists in the 100-H and 100-K Areas. Chromium is known to have reached groundwater and resulted in concentrations that require remedial measures but the vadose zone source of this contamination has not been positively identified. Identification and treatment of this contaminant source is an important part of meeting and maintaining groundwater cleanup objectives.

In the 300 area, extensive lead contamination was discovered during excavation. Prior knowledge of the extent of contamination would have allowed improved project planning and reduced excavation inefficiencies. This enhanced characterization information may potentially be useful in avoiding contract modifications during future remediation activities.

The 200 Area will be performing significant characterization efforts at soil waste sites through FY08. Optimally, in situ techniques would produce data that would eliminate the need for discrete sampling. However, less accurate techniques could cost effectively help determine the best locations to conduct more expensive analyses.

Benefit to the Project Baseline of Filling Need: In situ technologies may provide cost and schedule savings over current baseline methods involving soil boring, labor intensive sampling, and laboratory analysis.

Functional Performance Requirements: The cost effective technology needs to provide real-time, in situ measurement of heavy metals with field deployable instruments. Data must be easily downloaded into computer systems for analysis and retrieval. Detection limits down to required remediation levels would be preferable but higher detection level instruments that could be deployed economically at depth are also of interest. For the 300 Area, detection of lead at 100 mg/kg is required. The following remediation goals can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17 rev. 2): Cr (VI), 2.0 mg/kg; Hg, 24 mg/kg (0.33 mg/kg deeper than 15ft); and Pb, 353 mg/kg (10.2 mg/kg deeper than 15ft). The 200 Area sites do not currently have specific remediation goals. Detection of Nitrate at 30 mg/kg and Sodium at 25 mg/kg would be of use in the 200 Area tank farms. Analyses down to 200+ feet would be useful in some areas, but deployment to depths of greater than 15 ft is required. If possible, the technique should support the eventual replacement of the requirement for sample collection and analysis.

Work Breakdown Structure (WBS) No. : 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028, M-15-00, M-16-00

Justification For Need:

Technical: Highly accurate and easily operated instrumentation to measure the concentrations of heavy metals will facilitate accurate soil remediation planning and will reduce exposure to workers involved in characterization work.

Regulatory: Analyses completed as part of the effort to address this technology need will serve as the basis for reaching agreement with regulatory agencies on establishing performance objectives and criteria for remediation and closure of Hanford facilities. Also, information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. In addition, capability to collect this information would also be useful to support selection and monitoring of remediation alternatives.

Environmental Safety and Health: In situ technologies would reduce the need for invasive sampling and the related potential for worker exposure.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$10M. This estimate is based on an assumed savings of 1% of the total cost for the 100 Area of \$900M.

Cultural/Stakeholder Concerns: There are concerns that inadequate waste site characterization will be used to support decisions to leave waste in place.

Other: None

Current Baseline Technology: Borehole, cone penetrometer, cased wells, and test pits are used to gain access to the subsurface. Depending on the contaminant of concern, soil samples from the drill cuttings may be subjected to laboratory analysis.

Cost: Varied.

Waste: Drill cuttings and laboratory wastes.

How Long It Will Take: Soil remediation activities in the 100 and 300 Areas are planned for the next ten years. Soil activities in the 200 Area are scheduled to continue through 2018.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; John April, BHL, (509) 372-9632; Curt Wittreich, (509) 372-9586; Ashur R. Michael, BHL, (509) 372-9074; Tony Knepp, CHG, (509) 372-9514; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHL, (509) 372-9075; Michael J. Graham (200 Area), BHL (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert G. Mcleod, DOE, (509) 372-0096; Glenn I. Goldberg, DOE, (509) 376-9552; Robert M. Yasek, DOE, (509) 372-1270; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, IN SITU CHARACTERIZATION AND MONITORING OF SOIL CONTAMINATED BY RADIONUCLIDES

Identification No.: RL-SS16

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): All Soil Sites

PBS No.: RL-RC01 (RL-ER01), RC02 (RL-ER03), RL-CP01 (RL-ER02)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success |
|--------------------------------|---|

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as a high priority.

Need Title: Improved, In Situ Characterization and Monitoring of Soil Contaminated by Radionuclides

Need/Opportunity Category: Technology Need

Need Description: The extent of contamination in soil and burial ground sites is often poorly defined. A cost-effective technology that provides real-time, in situ measurement of radioactive contaminants (uranium, plutonium, cesium, cobalt, technetium-99, strontium-90, iodine, and selenium) in soils at depth is required to better define the contaminant plume boundaries prior to remediation and also to support long-term monitoring for performance validation of the completed remediation activity or to provide monitoring as part of Monitored Natural Attenuation.. Characterization of TRU is also needed for some 200 Area waste sites. In situ monitoring is also needed to support long term monitoring associated with long-term stewardship of contaminated soils.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/13

Characterization and remediation of the 200 Area sites began in FY99 and is expected to continue through 2018. Soil Remediation is ongoing in the 100 and 300 Areas, and is expected to be completed before 200

Area remediation. Tank farm characterization is ongoing with planning for remedial action and closure having started. The first tank farm is scheduled to be closed by 2014.

Problem Description: The approximate total volumes of soil requiring remediation at the Hanford Site (liquid waste disposal sites and burial grounds) are: 3.9 million cubic yards in the 100 Areas, approximately 10 million cubic yards in the 200 Areas, and 0.8 million cubic yards in the 300 Area. The 100 Area has over 340 contaminated soil sites that are expected to require remediation. Soil units include cribs, french drains, trenches, ponds, and retention basins that received radiologically and chemically contaminated liquid effluent from reactor and support operations. Cobalt and strontium-90 are the main radioactive contaminants of concern. The 300 Area has several soil sites that resulted from liquid disposal in ponds and trenches. Uranium is used as an indicator contaminant and soils with concentrations greater than 350 picocuries/gram in the top 15 feet are removed. The 200 Area contains approximately 1000 different soil and burial ground sites. Soil waste sites are predominantly the result of liquid discharges to cribs, ponds and ditches. The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or surface barrier placement strategies. Monitored natural attenuation is also considered a potential alternative. The target/indicator contaminants will be developed for the 200 Area as part of the characterization activities. However, plutonium, uranium, cesium, cobalt, technetium and strontium are likely to be the key indicator contaminants for many of the contaminated sites. Of primary importance is the need for in situ monitoring of the more mobile contaminants including technetium, strontium and uranium. The 200 Area will be performing significant characterization efforts at soil waste sites through FY08

Benefit to the Project Baseline of Filling Need: In situ technologies may provide cost and schedule savings over current baseline methods involving soil boring, labor intensive sampling, and laboratory analysis.

Functional Performance Requirements: The cost-effective technology needs to provide real-time, in situ measurement of radioactive contaminants with field deployable instruments. Data must be easily downloaded into computer systems for analysis and retrieval. Detection limits down to required remediation levels or levels at which remediation alternative decisions can be made would be preferable, but higher detection level instruments that could be deployed economically at depth are also of interest. If possible, the technique should support the eventual replacement of the requirement for sample collection and analysis. Detection of total uranium at 50 pCi/g is needed in the 300 Area to meet a 350 pCi/g remediation goal, but a lower detection limit may be required in the future. The following remediation goals can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17): U-233/234, 1.1 pCi/g; U-235, 1.0 pCi/g; U-238, 1.1 pCi/g; Pu-238, 37.4 pCi/g (1,123 pCi/g below 15 ft); Pu-239/240, 33.9 pCi/g (718,600 pCi/g below 15 ft); Cs-137, 6.2 pCi/g; Co-60, 1.4 pCi/g; Sr-90, 4.5 pCi/g; and Tc-99, 15 pCi/g. Analyses down to 200+ feet would be useful in some areas but deployment to depths between the surface and 50 ft would help supply missing information. The 200 Area sites do not currently have specific remediation goals, but contaminants of concern are the same as for the 100 Area with the addition of isotopes of iodine and selenium.

Work Breakdown Structure (WBS) No. : 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028, M-15-00, M-16-00

Justification For Need:

Technical: Highly accurate and easily operated instrumentation to measure the concentrations and movement of radioactive contaminants in situ will facilitate accurate remedial alternative decision making and soil remediation planning. In situ techniques will also reduce exposure to workers involved in characterization work.

Regulatory: Analyses completed as part of the effort to address this technology need will serve as the basis for reaching agreement with regulatory agencies on establishing performance objectives and criteria for remediation and closure of Hanford facilities. Also, information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. In addition, capability to collect this information would also be useful to support selection and monitoring of remediation alternatives.

Environmental Safety and Health: In situ technologies would reduce the need for invasive sampling and the related potential for worker exposure.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$10M. This estimate is based on an assumed savings of 1% of the total cost for the 100 Area of \$900M.

Cultural/Stakeholder Concerns: There are concerns that inadequate waste site characterization will be used to support decisions to leave waste in place.

Other: None.

Current Baseline Technology: Borehole, cone penetrometer, cased wells and test pits, are used to gain access to the subsurface. A sensitive hyper-pure germanium gamma detector adapted for bore hole use gathers radiation spectrums as it is lowered through a casing. Depending on the contaminant of concern, soil samples from the borehole may still require laboratory analysis.

Cost: Varied. Baseline characterization activities in the 200 Areas are estimated to be \$70M.

Waste: Drill cuttings and laboratory wastes.

How Long It Will Take: Activities in the 200 Area are scheduled to continue through 2018.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; John April, BHL, (509) 372-9632; Curt Wittreich, (509) 372-9586; Ashur R. Michael, BHL, (509) 372-9074; Tony Knepp, CHG, (509) 372-9514; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHL, (509) 372-9075; Michael J. Graham (200 Area), BHL (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert G. Mcleod, DOE, (509) 372-0096; Glenn I. Goldberg, DOE, (509) 376-9552; Robert M. Yasek, DOE, (509) 372-1270; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-LIFE WASTE ISOLATION SURFACE BARRIER

Identification No.: RL-SS17

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 200 Area Remedial Action and Waste Management Units

PBS No.: RL-CP01 (RL-ER02)

Waste Stream: Disposition Map Designations: ER-14 [technical risk score 5]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>
<u> </u>
<u> </u> | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success |
|--|---|

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as their highest priority.

Need Title: Long-Life Waste Isolation Surface Barrier

Need/Opportunity Category: Technology Need

Need Description: Surface barriers are remediation options for Hanford waste sites contaminated with low-level radionuclides and transuranics and/or chemical contaminants. In some cases, the radioactive contaminants have half-lives of thousands of years. Concern exists regarding the integrity of barrier designs and the definition of adequate testing to verify barrier performance. This technology need relates to the generation and subsequent regulatory acceptance of adequate design, selection, validation, and monitoring results. Acceptance of these results will allow an environmentally sound, cost-effective, graded design approach for barrier implementation at the Hanford site.

Long-term monitoring techniques are also needed to support monitoring of barrier performance and long-term stewardship of contaminated soils.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Construction of surface barriers at a significant scale will likely start in FY2008 when all assessments are required to be completed. To have RODs in place for barriers by FY2008, significant performance data is still needed. Long-term monitoring techniques, are currently needed to collect performance monitoring data for the existing Hanford Barrier and to plan the monitoring program for a modified RCRA C barrier

treatability test which is expected to start in FY2002. Remediation of the 200 Area is currently planned to continue through 2018.

Problem Description: Fifty years of defense plutonium production resulted in the creation of a large number of solid waste burial ground sites in Hanford's 100, 200, and 300 Areas. The 200 Area is located on the central plateau and contains the spent fuel extraction and processing facilities and the radioactive waste storage tanks. Hanford's burial grounds contain a variety of solid waste debris, including construction waste, discarded equipment, and protective clothing. Much of this waste is contaminated with low-level radioactive materials, as well as transuranics.

The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or surface barrier placement strategies. Sites within areas that will be used for waste management and other industrial uses or sites where capping provides better, more cost effective protection of human health and the environment are the main candidates for surface barriers. The majority of waste sites in the 200 Areas are expected to be remediated with surface barriers. Failure to establish acceptable graded surface barrier could result in excavation requirements that would be cost prohibitive.

In FY 1998, Bechtel Hanford Inc. and Pacific Northwest National Laboratory completed four-years worth of full-scale performance testing and monitoring for the Hanford Prototype Barrier as part of a treatability test. Additional, but more focused field performance testing and monitoring continues to date to enhance the long-term performance record. The purpose of this treatability test was to demonstrate the effectiveness of construction techniques and barrier performance. Data from this test could also be used to demonstrate acceptability of less robust graded barriers for use at the Hanford Site, since they share common design features. Data collected to date shows that the barrier works as designed, but an acceptable methodology for extrapolating short-term data into long-term performance is still required. In addition, full-scale performance testing is needed for the other graded barrier designs which are expected to have broader application in the 200 Areas than the Hanford Barrier design.

As barrier deployment enters the detailed design phase, considerations relating to performance of adjacent barriers (and interconnected barriers), side-slope stability, and waste site identification/warning systems will need to be addressed.

Areas that are presently not funded that require further study prior to deployment of barriers at waste sites include:

- (1) Confirming the longevity and durability of the low permeability layer (e.g., asphalt or geomembrane) by conducting accelerated aging tests and stress/strain analysis to ensure that this component will not degrade during its proposed design life.
- (2) Evaluating long term monitoring techniques, including a long term, easy to use, soil moisture measurement device to monitor the cap performance. These techniques would ideally be automated and non-intrusive with minimal potential for creating a preferential pathway circumventing the barrier integrity.
- (3) Evaluating the potential for differential settlement of soils and wastes beneath the surface barrier and the impacts of this differential settlement on barrier integrity are required to establish maximum allowable settlement criteria;
- (4) Developing a model for extrapolating short-term data to address long-term performance that is acceptable to the DOE and regulators;
- (5) Evaluating alternate materials (e.g., to asphalt) and reduced thicknesses of the barrier components to allow a graded approach to barrier application;
- (6) Side slopes that use coarse materials such as gravel or large rocks for slope stability increase infiltration in those areas. This edge effect needs to be analyzed to determine if this is a significant issue that requires design changes;

- (7) Techniques for subgrade modification or engineering stabilization of waste forms are needed to provide a stable foundation for emplacement of a surface barrier (e.g., decrease void space to eliminate subsidence potential and minimize differential settlement)

Benefit to the Project Baseline of Filling Need: Improved information about barrier performance and appropriate barrier designs will aid in selecting the most cost effective remediation approach.

Functional Performance Requirements: Major regulatory drivers for cover design are 10 CFR 61 (NRC), 40 CFR 264 and 265 (RCRA), and 40 CFR 191 (EPA). Performance criteria for barrier designs depend on waste categories. DOE/RL has identified three conceptual surface barrier design options that provide various levels of environmental protection to provide a graded approach for isolation of different types waste (DOE/RL-93-33, Rev. 0). The most robust barrier design presently identified is the “Hanford Barrier” with a design life of 1,000 years, water infiltration limits to less than 0.05 cm/yr and erosion limits of less than 4,500 kg/ha (2 tons/acre).

Work Breakdown Structure (WBS) No. : 1.4.03.3.1 (RL-CP01)

TIP No.: TIP 0002

Relevant PBS Milestone: PBS-MC-027, M-15-00, M-16-00

Justification For Need:

Technical: Installation of long-term barrier options with design lives of hundreds or more years requires very high quality testing to confidently predict design performance.

Regulatory: CERCLA, RCRA, MTCA provides requirements for environmental remediation. DOE Order 435.1 (Radioactive Waste Management) provides requirements for radioactive waste.

Environmental Safety and Health: A properly installed barrier will significantly reduce risk to human health and the environment at uncontrolled surface waste sites.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$300M. This estimate is based on an assumed savings of 10% of the total cost for the 200 Area of \$2.8B.

Cultural/Stakeholder Concerns: Hanford stakeholders have expressed the desire for highly predictive performance testing of barrier designs prior to selection of barriers as remediation options at waste sites. Additionally, a major environmental impact identified in the Hanford Remedial Action Environmental Impact Statement is the mining of materials for surface barrier construction from the McGee Ranch of the Hanford Site. The McGee Ranch area is a wildlife corridor that many see as vital in maintaining the unique shrub steppe biological community in the area.

Other: This need is DOE complex wide for remedial action and waste management units. This need is also applicable to other US government agencies, as well as private environmental restoration activities.

Current Baseline Technology: Excavate and dispose.

Cost: Currently, surface barriers are the selected baseline approach for many of the waste sites in the 200 Area.

Waste: None

How Long It Will Take: Waste site remediation activities in the 200 Area are currently planned to continue through 2018.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Curt Wittreich, (509) 372-9586; Tony Knepp, CHG, (509) 372-9514; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert M. Yasek, DOE, (509) 372-1270; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED DETECTION AND SEGREGATION OF TRU WASTE (DEBRIS)

Identification No.: RL-SS18

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Selected burial ground sites in the 200 and 300 Areas

PBS No.: RL-CP01 (RL-ER02) and RL-RS01 (RL-ER03)

Waste Stream: Disposition Map Designations: T3-ER [technical risk score 5]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

Need Title: Improved Detection and Segregation of TRU Waste (Debris)

Need/Opportunity Category: Technology Need

Need Description: Burial grounds in the 200 and 300 Areas received waste contaminated with plutonium and other TRU constituents. The final remediation methods for sites suspected of containing TRU waste has not been established. If excavated and disposed on site, waste soils or debris with more than 100 nCi of TRU contamination per gram of waste does not meet current waste acceptance criteria for on site disposal and would need to be segregated for disposal at the Waste Isolation Pilot Plant.

Specific to the 618-10 and 618-11 burial grounds, methods are needed to detect and segregate TRU and high dose rate contamination associated with debris in the burial grounds. Additional information about the contents of the 618-10 and 618-11 burial grounds is available in “Characterization of the 618-11 Solid Waste Burial Ground, Disposed Waste, and Description of the Waste-Generating Facilities” (Waste Management Federal Services, 1998, HNF-EP-0649, Rev. 0).

Schedule Requirements:

Earliest Date Required: 9/30/05

Latest Date Required: 9/30/12

Burial sites that potentially contain TRU waste are not scheduled for remediation in the 300 Area for the next 5-10 years; 200 Area burial grounds are not scheduled for remediation for the next ten years.

Problem Description: Fifty years of defense plutonium production resulted in the creation of a large number of solid waste burial ground sites in Hanford’s 100, 200, and 300 Areas. The 100 Areas are located along the Columbia River and include nine nuclear reactors previously used for plutonium production. No TRU materials are known to have been disposed in the 100 Area burial grounds. The 300

Area is also located along the Columbia River and contains the fuel fabrication facilities. The 200 Area is located on the central plateau and contains the spent fuel extraction and processing facilities and the radioactive waste storage tanks. Selected burial grounds in both the 200 and 300 Areas have received waste contaminated with plutonium and other TRU constituents. The baseline for the 300 area burial ground sites is excavation and disposal on site. Strategies for remediation of the 200 Area burial ground sites are being revised.

Hanford's burial grounds contain a variety of solid waste debris that may require size reduction and/or further characterization to confirm that the item should not be classified as TRU waste prior to disposal. Plans are to use conventional excavation equipment and grizzlies to remove and separate the debris. The separated material will then be staged until determination of the TRU contaminant concentrations is complete. There are concerns that these operations will reduce excavation efficiencies and increase costs.

Benefit to the Project Baseline of Filling Need: Technologies appropriate for handling TRU waste need to be identified to support the project baseline for suspected TRU-containing sites such as the 618-10 and 618-11 burial grounds.

Functional Performance Requirements: Technologies must be able to rapidly detect and segregate TRU contaminants at concentrations greater than 100 nCi per gram of waste on a variety of different waste geometries. The 618-10 and 618-11 burial grounds contain specific types of waste forms that will require segregation of TRU material. These burial grounds received high-level, low-level, and TRU waste. Some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in the vertical pipe units and caissons. Waste materials in vertical pipe units and caissons may be packed inside cans of various sizes (e.g., 1-L, 19-L, 57-L [quart, 5-gallon, 15 gallon]). Some TRU waste was encased in concrete for disposal to burial ground trenches. Radioactive isotopes in these burial grounds may include ^{14}C , ^{60}Co , ^{65}Zn , ^{90}Sr , ^{103}Ru , ^{131}I , ^{137}Cs , ^{144}Ce , ^{147}Pm , ^{226}Ra , ^{232}Th , ^{233}U , ^{235}U , ^{237}Np , ^{238}U , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Am , and ^{244}Cm .

Work Breakdown Structure (WBS) No. : 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01); 1.4.03.2.1 (RL-RS01)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-027, PBS-MC-028, M-16-00

Justification For Need:

Technical: Rapid field methods for detection and segregation of TRU materials are not available.

Regulatory: TRU waste does not meet the current waste acceptance criteria and must be stored in approved facilities until a permanent TRU disposal site (i.e. WIPP) becomes available.

Environmental Safety and Health: Improved handling of waste debris may reduce the potential for worker exposures and contaminant releases.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$20M. This estimate is based on an assumed savings of 5% of the total cost for excavation of TRU burial grounds of \$370M.

Cultural/Stakeholder Concerns: No stakeholder concerns are likely.

Other: None.

Current Baseline Technology: Conventional excavation equipment for removal with grizzlies for separation.

Cost: Estimates to complete excavation and disposal of 300 Area burial grounds that contain TRU waste are nearly \$370M. Occurrence of inefficiencies during the excavation process could have substantial cost impacts.

Waste: None

How Long It Will Take: Burial ground remediation activities in the 300 Area are planned for next ten years. Burial ground remediation activities in the 200 Area are likely to extend well beyond the ten year time period.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Richard A. Carlson, BHI, (509) 372-9632; Curt Wittreich, (509) 372-9586; Ashur R. Michael, BHI, (509) 372-9074; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHI, (509) 372-9075; Michael J. Graham (200 Area), BHI (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert G. Mcleod, DOE, (509) 372-0096; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DETECTION, HANDLING, AND TREATMENT OF PYROPHORIC MATERIALS IN BURIAL GROUNDS

Identification No.: RL-SS19

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Selected burial grounds in the 300 Area

PBS No.: RL-RC02 (RL-ER03) and RL-RS01 (RL-ER03)

Waste Stream: Disposition Map Designations: ER-06 [technical risk score 4], ER-08 [technical risk score 4], ER-05 [technical risk score 4], ER-01 [technical risk score 4], ER-02 [technical risk score 4]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

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☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success |
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Need Title: Detection, Handling, and Treatment of Pyrophoric Materials in Burial Grounds

Need/Opportunity Category: Technology Opportunity

Need Description: Several different operations that used or generated pyrophoric materials were conducted in the 300 Area. The quantity of these materials in 300 Area burial grounds is not well documented but at least 350 and potentially as many as 1500 drums of uranium machining chips have already been discovered. Improved methods for detecting, handling, and treating suspect pyrophoric materials are required. Other pyrophoric materials that are suspected to exist in currently unexcavated burial grounds include zircaloy, magnesium and calcium metals.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/12

Three hundred and fifty drums of uranium chips are scheduled for treatment. As many as 1200 additional drums will require subsequent treatment.

Problem Description: Fifty years of defense plutonium production resulted in the creation of a large number of solid waste burial ground sites in Hanford’s 100, 200, and 300 Areas. The 300 Area contained the fuel fabrication facilities where uranium and zircaloy were machined. These processes generated scrap machining chips/filings that can have pyrophoric tendencies. Additionally, Hanford may have received and buried shipments of uranium chips and other pyrophoric materials from other DOE sites. At least 350 and as many as 1500 drums of uranium shavings have been discovered in the 618-4 burial

ground. There are records that indicate that drums of zircaloy chips were also placed in some 300 Area burial grounds. In addition to machining, uranium was also recovered in pyrometallurgical processes that used magnesium and calcium metals that can also have pyrophoric tendencies. The amount of pyrophoric materials in the 100 and 200 Areas is not known.

There is currently no good test to determine if these materials retain their pyrophoric tendencies or if they have sufficiently oxidized to the point that they no longer need special handling. An easy, safe test to make this determination would reduce the need to conservatively handle all suspect materials as pyrophorics. The current baseline for handling uranium chips prior to treatment/disposal is to over pack the chips in drums of non-hazardous oil. This technique is labor intensive and creates additional waste volume. The baseline for treatment of uranium chips has not been established but solidification is often used. This technique is generally accepted as a method to remove the pyrophoric nature of uranium chips but can generate hydrogen through reaction with water and does not permanently remove the pyrophoric tendency of the material if the matrix breaks down.

Benefit to the Project Baseline of Filling Need: Technologies appropriate for handling pyrophoric waste need to be identified to support the project baseline; for example at the 618-4 burial ground.

Functional Performance Requirements: Detection technologies should be able to test small amounts of excavated materials to determine if they have pyrophoric tendencies and require special handling. Improved handling technologies should be more cost effective than over packing in oil filled drums or other baseline stabilization techniques. Treatment technologies need to remove the pyrophoric nature of the material and be more cost effective than solidification.

Work Breakdown Structure (WBS) No. : 1.4.03.2.1 (RL-RS01); 1.4.03.1.2 (RL-RC02)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-028

Justification For Need:

Technical: Current detection methods would require all containers in selected burial grounds to be treated as suspect pyrophoric material. This will reduce excavation efficiencies and increase costs. Current treatment technologies are not permanent or are expensive.

Regulatory: Waste acceptance criteria at most disposal sites require that pyrophoric materials are treated prior to disposal.

Environmental Safety and Health: Improved handling of suspect pyrophoric materials may reduce the potential for worker exposures and contaminant releases.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

The estimated life-cycle cost savings associated with filling this need is \$5M. This estimate is based on an assumed savings of 0.5% of the total cost for excavation of 100 and 300 Area burial grounds of \$700M.

Cultural/Stakeholder Concerns: Stakeholder concerns have not been established for this need.

Other: None.

Current Baseline Technology: Materials are assumed to retain their pyrophoric nature and are over packed in drums of non-hazardous oil. The baseline technology has not been established but solidification has been used elsewhere in the DOE complex.

Cost: Estimates to complete excavation and disposal of all the burial grounds in the 100 and 300 Areas is nearly \$700M. Occurrence of inefficiencies during the excavation process could have substantial cost impacts.

Waste: None

How Long It Will Take: Burial ground remediation activities in the 100 and 300 Areas are planned for the next ten years. Burial ground remediation activities in the 200 Area are scheduled to continue through 2018.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; John April, BHI, (509) 372-9632; Ashur R. Michael, BHI, (509) 372-9074; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen, BHI, (509) 372-9075

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Robert G. Mcleod, DOE, (509) 372-0096; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED METHODS FOR DEBRIS HANDLING AND SEGREGATION

Identification No.: RL-SS20

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): All burial ground sites in the 100 and 300 Areas

PBS No.: RL-RC01 (RL-ER01), RL-RC02 (RL-ER03), RL-RS01 (RL-ER03)

Waste Stream: Disposition Map Designations: ER-06 [technical risk score 4], ER-08 [technical risk score 4], ER-05 [technical risk score 4], ER-01 [technical risk score 4], ER-02 [technical risk score 4], T3-ER [technical risk score 5]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

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☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success |
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Need Title: Improved Methods for Debris Handling and Segregation

Need/Opportunity Category: Technology Need

Need Description: A large number of waste burial grounds will be excavated and disposed on site. Improved methods are needed for handling and segregating waste debris that requires further characterization or size reduction prior to disposal.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/12

Burial grounds exist in the 100 and 300 Areas. The first burial ground excavation (located in the 300 Area) began in FY98. The schedule for excavation of burial grounds in the 100 and 300 Areas is uncertain.

Problem Description: Hanford’s burial grounds and liquid waste disposal sites contain a variety of solid waste debris that may require special handling, size reduction, and/or further characterization (e.g. to confirm that the item should not be classified as TRU waste) prior to disposal. Specific examples of problems associated with handling debris waste include:

- (1) Drummed pyrophoric wastes that require overpacking in non-hazardous mineral oil while awaiting final treatment disposition.
- (2) Drummed acid and chemical waste that required sampling to determine the required level of personal protective equipment.

- (3) Pipes greater than 18" in diameter that must be sliced along their axis to meet waste disposal criteria. These disposal criteria help assure that voids are not left in the disposal cells that could result in waste settling and closure cap instabilities.
- (4) Tar/asbestos coatings on pipes that must be scraped off and handled as asbestos waste.
- (5) Large pieces of concrete need to be demolished to facilitate excavation, transport, and disposal

These operations reduce excavation efficiencies and increase costs. Improved methods for dealing with these and other debris handling issues that will arise in future operations are required.

Benefit to the Project Baseline of Filling Need: Technologies appropriate for handling problematic debris need to be identified to support the project baseline.

Functional Performance Requirements: Technology must reduce inefficiencies and costs associated with handling solid debris.

Work Breakdown Structure (WBS) No. 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.2.1 (RL-RS01)

TIP No.: TIP 0001, TIP 0003

Relevant PBS Milestone: PBS-MC-026, PBS-MC-028

Justification For Need:

Technical: The wide variety of wastes placed in burial grounds is likely to require several different or very robust handling/segregation technologies.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety and Health: Improved handling of waste debris may reduce the potential for worker exposures and contaminant releases.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$10M. This estimate is based on an assumed savings of 1% of the total cost for excavation of 100 and 300 Area burial grounds of \$700M.

Cultural/Stakeholder Concerns: No stakeholder concerns are likely.

Other: None.

Current Baseline Technology: Conventional excavation equipment for removal with grizzlies for separation.

Cost: Budget forecast for 300 Area burial ground activities is about \$3.1M. Estimates to complete excavation and disposal of all the burial grounds in the 100 and 300 Areas is nearly \$700M. Occurrence of inefficiencies during the excavation process could have substantial cost impacts.

Waste: None

How Long It Will Take: Burial ground remediation activities in the 100 and 300 Areas are planned for next ten years.

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; John April, BHL, (509) 372-9632; Ashur R. Michael, BHL, (509) 372-9074; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen, BHL, (509) 372-9075

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, COST-EFFECTIVE METHODS FOR SUB-SURFACE ACCESS TO SUPPORT CHARACTERIZATION AND REMEDIATION

Identification No.: RL-SS25

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01), RL-RC01 (RL-ER01), RL-RC02 (RL-ER03), RL-CP01 (RL-ER02),
RL-RC01 and RL-CP01 (RL-ER08)

Waste Stream: Disposition Map Designation: ER-03 [technical risk score 3], ER-04 [technical risk score 3], ER-10 [technical risk score 5], ER-18 [technical risk score 5], ER-14 [technical risk score 5]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as a high priority.

Need Title: Improved, Cost-Effective Methods for Sub-Surface Access to Support Characterization and Remediation.

Need/Opportunity Category: Technology Need

Need Description: The Hanford site contains large volumes of contaminated vadose zone and aquifer soils. In some areas, these soils are located at depths of 500 ft while access to other soils is restricted by the presence of surface or near surface objects such as buildings or underground tanks. The Hanford geology also is quite varied and ranges from unconsolidated silty sands to gravels and cobbles. Cost effective technologies that allow access to this wide variety of sediments for both characterization and remediation are required. Improvements in both vertical and horizontal access techniques are desired.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Characterization and remediation activities are ongoing.

Problem Description: The Hanford geology that must be accessed by these technologies is divided into three primary components; the Hanford Formation (upper sediment unit), the Plio-Pleistocene Unit (interlayer in the 200 West Area), and the Ringold Formation (lower sediment unit). The Hanford Formation is comprised of unconsolidated sands, gravels, and fine-grained slackwater deposits from cataclysmic floods of the Pleistocene period. The relative proportion of sand, gravel, and fine-grain deposits is dependent on the location within the Hanford site. The Plio-Pleistocene Unit (1-m to 5-m thick) consists of a caliche cemented layer, well-cemented calcium carbonate enriched sediment and a loess composed of fine grained sand and silt. The Ringold Formation is comprised of unconsolidated and semi-consolidated fluvial and lacustrine sediments ranging from gravels with interbedded silt and sand lenses to muddy sandy gravels with interbedded sand and muddy sand lenses. The 100 Area subsurface is primarily comprised of Hanford Formation. The 200 East Area is primarily comprised of Hanford and Ringold Formation. The 200 West Area is a mixture of the three components.

Access technologies are used for both characterization and remediation at several different areas throughout the Hanford Site. A few specific examples are discussed to illustrate the different needs.

Groundwater operable unit 200-ZP-1 is located in the northern half of the 200 West Area. Carbon tetrachloride in this operable unit extends in groundwater over a 4.5 square mile area. Depth to the water table is 270 feet. The ultimate remediation goal for the CCl_4 plume is to eliminate a sufficient amount of contamination so that the plume concentration will not exceed 5 ppb at the 200 Area plateau boundary. An interim ROD has been issued requiring an interim remedial measure (IRM) to treat the 2000-3000 ppb portion of the carbon tetrachloride plume northwest of Z Plant (excluding the T Plant plume). Contaminated groundwater within the operable unit is being pumped from the aquifer, then treated with an air-stripping unit followed by vapor phase granular activated carbon polishing. Initial modeling indicates that pump and treat will need to be expanded and operated for 33 to 56 years to meet stated objectives. Other remediation activities are being considered but costs to access this deep and large contaminant plume limit practical options.

The 100-H, 100-D and 100-K Areas contain three chromium plumes. The areal extent of the north plume is about 2,000' x 4,000' and the south plume is about 2,000' x 2,000'. Both plumes have an average thickness of about 15 feet with concentrations ranging from 60 to 2000 ppb. Depth to the water table is 85 feet. Pump & Treat and In Situ Redox Manipulation (ISRM) barrier technology which both rely on conventional vertical well technology are being used to control the migration of portions of these plumes. However, less expensive access technologies, and potentially horizontal well technologies, would reduce the cost of characterizing the location of the plumes and installing/monitoring the effectiveness of these solutions.

In the 100-N Area, strontium-90 (half-life 29.3 years) is present in groundwater at activities up to 6000 pCi/L. Depth to the water table is 70-80 feet at the source. Plume thickness ranges from 13 to 40 feet. This problem is currently being assessed through the Innovative Treatment Remediation Demonstration (ITRD) process. This process reduces communication and regulatory barriers and develops an operational test and evaluation program that leads to implementation of the best technology. This assessment is ongoing and will continue into FY99, however, several potential solutions that are being considered in this process would benefit from less expensive access technologies.

The Hanford site is currently investigating methods (e.g. cone penetrometers) to cost effectively access soils near and below underground storage tanks and soil waste sites. These investigations have been productive for near surface soils but are limited in deployment depth in many types of Hanford soil. Recent borehole spectral gamma data in the 200 Area indicate that cesium-137 has migrated deeper than previously expected at both the SX and BX tank farms. Groundwater data for several tank farm waste management areas also suggest that pathways through the vadose zone exist and could impact

groundwater quality. These observations suggest that fundamental assumptions about contaminant mobility that support single shell tank cleanup options and schedules may be incorrect. However, drag down of contamination or preferential paths generated by vertical wells may also be the cause of some of this contamination. Access technologies that do not drill through overlying contaminated soils and can reach the required depths to groundwater in the 200 Area could help confirm the existence of these contaminants at depth and determine appropriate actions. More cost effective access than the current baseline borehole techniques would provide a significant cost impact in the 200 Area because of the large number of waste sites that need to be characterized over the next ten years.

Benefit to the Project Baseline of Filling Need: Improved access technology may significantly decrease the current costs associated with the baseline drilling technologies.

Functional Performance Requirements: Access technologies should be as cost effective as, or better than, conventional vertical well drilling access technologies (e.g. <\$300 per ft in non-radiation zones, <\$2000/ft in radiation zones). The technology should allow access to soils at depths up to 500 ft and allow for access to long (1000-5000 ft) horizontal sections of contaminated soils. The technology should be able to accurately access specific portions of contaminated soils and therefore needs good directional and location control. The technology must be appropriate for the variety sediments at Hanford. The technology should minimize the generation of secondary wastes and support both characterization and remediation activities. Use of drilling mud is generally not possible or very limited at Hanford and is not applicable to characterization boreholes.

Work Breakdown Structure (WBS) No. 1.4.03.1.1 (RL-RC01); 1.4.03.1.2 (RL-RC02); 1.4.03.3.1 (RL-CP01); 1.4.03.4.4 (RL-SS04)

TIP No.: N/ A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, PBS-MC-028, M-15-00, M-16-00

Justification For Need:

Technical: There are two main technical justifications for this need. The first is that the large size of several Hanford plumes and the depth of some contamination, especially in the 200 Area, limits practical remediation options unless the expense of accessing the contaminated areas can be reduced. The second justification relates to characterization. Significant decisions about the treatment of the vadose zone in the 200 Area must be based on a sufficient amount of characterization data that is not effected by the sampling method.

Regulatory: Capability to collect this information would also be useful to support selection and monitoring of effective remedial alternatives.

Environmental Safety and Health: Improved access technologies could help reduce secondary waste generated during drilling operations and reduce the potential for worker exposure.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$50M. This estimate is based on an assumed savings of 25% of the projected assessment cost for the 200 Area of \$80M plus additional savings for remediation technology deployments.

Cultural/Stakeholder Concerns: Long horizontal wells could reduce the amount of surface damage to culturally sensitive areas by limiting the number of surface penetrations required to treat a given site.

Other: None.

Current Baseline Technology: Air rotary, sonic, and cable tool drilling are the primary access technology used at the Hanford Site.

Cost: Approximate drilling costs are \$300 per foot in areas with low levels of contamination. Cost per foot can be as high as \$2000 per foot in more contaminated areas like the tank farms.

Waste: Drill cuttings and PPE from drilling operations.

How Long It Will Take: The baseline drilling techniques can drill at a rate of up to about 300 ft per week.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; John April, BHI, (509) 372-9632; Curt Wittreich, (509) 372-9586; Ashur R. Michael, BHI, (509) 372-9074; Jared D. Isaacs, BHI, (509) 372-9162; Tony Knepp, CHG, (509) 372-9514; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHI, (509) 372-9075; Michael J. Graham (200 Area), BHI (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Robert G. Mcleod, DOE, (509) 372-0096; Glenn I. Goldberg, DOE, (509) 376-9552; Robert M. Yasek, DOE, (509) 372-1270; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED METHODS FOR DETERMINING DISTRIBUTION OF BETA EMITTING CONTAMINANTS IN SUBSURFACE SOILS

Identification No.: RL-SS26

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): 100-NR-2, 200 Area Remedial Action and Waste Management Units

PBS No.: RL-RC01 (RL-ER01), RL-CP01 (RL-ER02), RL-SS04 (RL- VZ01)

Waste Stream: Disposition Map Designations: ER-14 [technical risk score 5]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as a high priority.

Need Title: Improved Methods for Determining Distribution of Beta Emitting Contaminants in Subsurface Soils

Need/Opportunity Category: Technology Need

Need Description: Contaminants with low Kds and long half-lives like Tc-99 and I-129 tend to represent the greatest health risks in long-term risk assessments for the 200 Area tank farms. Also, strontium contamination in the 100 Area soils and groundwater presents a near term environmental concern due to its close proximity to the Columbia River. However, it is difficult to measure the inventories and distribution of these contaminants because they only emit beta particles that do not penetrate the surrounding soil. Therefore, the only way to currently obtain data in the vadose zone is through the costly collection of soil samples. Improved, more cost-effective methods of accessing contaminated soils, taking soil samples, and/or measuring the concentration, and/or in-situ monitoring of beta emitting contaminants are required. In situ monitoring is also needed to support long term monitoring associated with long-term stewardship of contaminated soils.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/13

The ER and RPP programs have started vadose zone characterization in the 200 Areas and remediation is expected to extend to 2018. The monitoring (contaminant location and movement over time) data is needed at an early date to support technically sound cleanup decisions.

Problem Description: There are two main areas at the Hanford Site that would benefit from more cost-effective characterization techniques for beta emitting contaminants. The first area is in the vadose zone below the 200 Areas tank farms and soil sites. Recent borehole spectral gamma data at the Hanford Site indicate that cesium-137 has migrated deeper than previously expected at both the SX and BX tank farms. Groundwater data for several tank farm waste management areas also suggest that pathways through the vadose zone exist and could impact groundwater quality. These observations suggest that fundamental assumptions about contaminant mobility that support single shell tank cleanup options and schedules may be incorrect, a finding echoed by a recent peer review and the National Academy of Sciences. These findings have led to greater concerns related to transport of high mobility contaminants like Tc-99, Sr-90 and I-129 since these waste components are not detected by spectral gamma logging. Methods to cost effectively supply supplemental spectral beta and geophysical data are needed to (1) help quantify and understand the present distribution of these contaminants, (2) model future transport and health impacts, and (3) determine the best remediation strategy.

The second main area is 100-N. This area is located near the Columbia River and includes one nuclear reactor previously used for plutonium production. In the 100-NR-2 operable unit, the primary sources of contamination are ditches and cribs. Groundwater in the 100 Area ultimately discharges to the Columbia River. The principal contaminant, strontium-90, is a beta emitting contaminant present in groundwater at activities up to 6000 pCi/L. Maximum concentrations of the plume range from 4,000-6,000 pCi per liter with depth to the water table of 70-80 feet at the source. The estimated total inventory of contaminant in both the groundwater and soils ranges from 75 to 89 curies. However, the contaminant distribution in the vadose zone is not well characterized and the potential impact on groundwater is not fully understood. Additional characterization data would help determine the long-term risk associated with this contamination and determine the best method for remediation.

Benefit to the Project Baseline of Filling Need: Improved measurement technology may significantly decrease the current costs associated with the baseline discrete sampling. Additionally, use of improved measurement techniques may provide more data to quantify contaminant inventories.

Functional Performance Requirements: The most general functional requirement is that the new method must generate data about these contaminants in a more cost-effective manner than the baseline. Either more effective retrieval of soil samples or in situ detection capabilities can be used to obtain this objective. More effective soil retrieval methods must be capable of recovering contaminated samples with minimal disturbance (e.g., no drilling fluids) down to a depth of 200+ ft. Sample retrieval techniques must also control drag down of contaminants from near surface soils and also minimize the generation of secondary waste. In situ monitoring capabilities should be capable of deployment at depths greater than 200 ft and be able to determine contaminant concentrations of beta emitting contaminants to levels as low as a few pCi/gram, but would also be beneficial in the 10-100 pCi/g range for screening purposes. The detection techniques should also be able to distinguish specific contaminant species in the presence of other co-contaminants and supply real-time or near real-time information. Sampling or detection techniques that could take advantage of existing boreholes cased are also of interest.

Work Breakdown Structure (WBS) No. 1.4.03.1.1 (RL-RC01); 1.4.03.3.1 (RL-CP01); 1.4.03.4.4 (RL-SS04)

TIP No.: N/A

Relevant PBS Milestone: PBS-MC-026, PBS-MC-027, M-15-00, M-16-00

Justification For Need:

Technical: Discrete sampling is the only technology currently available to collect information about these types of contaminants. This data is required to better understand current inventories and future impacts.

Regulatory: Capability to collect this information would also be useful to support selection and monitoring of effective remedial alternatives.

Environmental Safety and Health: Contaminant inventories are fundamental to prediction of environmental and human health effects due to groundwater and Columbia River exposure pathways, as called for in the CRCIA requirements document and cleanup related risk assessments. Improved in situ measurement techniques would also reduce the potential for worker exposure if discrete sampling is avoided.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$4M. This estimate is based on an assumed savings of 5% of the projected assessment cost for the 200 Area of \$80M.

Cultural/Stakeholder Concerns: Lack of contaminant mobility data is a major concern among stakeholders.

Other: None.

Current Baseline Technology: Well or borehole drilling with discrete sampling

Cost: The current cost depends on the location and drill cuttings disposal costs. Well drilling costs in the 100 area are on the order \$300 per ft while the costs in the 200 area tank farms are as much as \$2,000 per ft.

Waste: Drill cuttings and PPE required during drilling operations.

How Long It Will Take: Current discrete sampling has information turn around times of several weeks.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; John April, BHI, (509) 372-9632; Curt Wittreich, (509) 372-9586; Ashur R. Michael, BHI, (509) 372-9074; Tony Knepp, CHG, (509) 372-9514; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: V. R. (Vern) Dronen (100 and 300 Areas), BHI, (509) 372-9075; Michael J. Graham (200 Area), BHI (509) 372-9179

DOE End-User/Representative Point-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; Bryan L. Foley, DOE, (509) 376-7087; Glenn I. Goldberg, DOE, (509) 376-9552; Robert M. Yasek, DOE, (509) 372-1270; Owen Robertson, DOE, (509) 373-6295

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF URANIUM IN GROUNDWATER

Identification No.: RL-SS47

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: DOE-RL/Hanford

PBS No.: RL-CP01 (RL-ER08)

Operable Unit(s): 200-UP-1

Waste Stream: Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]

TSD Title: N/A

Waste Management Unit: N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

☐
☒
☐	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Cost-effective, In Situ Remediation of Uranium in Groundwater

Need/Opportunity Category: Technology Need

Need Description: In situ remediation of uranium in groundwater by stabilization or by enhancing the mass removal rate of the current pump-and-treat system is needed. In situ processes need to be more efficient than current baseline pump-and-treat operations and provide an endpoint suitable for meeting the remediation objectives.

Schedule Requirements:

Earliest Date Required: 7/1/01

Latest Date Required: 1/1/05

Pump and treat operations are ongoing for groundwater remediation. Operations are scheduled for review of effectiveness and alternate remedial approaches by the regulators in FY05. The ROD could be amended at this time. It would be beneficial to complete the technology work by this date.

Problem Description: The 200-UP-1 Groundwater Operable Unit is located in the southern half of the 200 West Area. Uranium, a primary contaminant of concern, is present in groundwater, as is technetium-99.

The uranium plume covers an overall area of about 663,620 m² (above 20 µg/L). The water table is approximately 255 feet below ground surface at this site. Most of the uranium contamination is located in the upper 15 m or less of the aquifer. The baseline remediation area is 60,575 m² in area, or just over 9%

of the total plume. The remedial objective of the interim ROD is to reduce contaminant concentrations to 480 µg/L. The maximum concentration of uranium in the groundwater was 2,600 µg/L in fiscal year 1999.

The concentrations of uranium have been slow in responding to the pump-and-treat remediation, especially in comparison to technetium-99, which has achieved the remedial action objective of 9,000 pCi/L in all but a couple of wells. The difference in remediation rates between uranium and technetium-99 is probably due to uranium's propensity to sorb to sediments. Additional information regarding the geochemical groundwater conditions and the sorption processes relevant for uranium in the site sediments is expected over the next two years as scientific studies of these issues are completed.

Benefit to the Project Baseline of Filling Need: The benefit to the project baseline would be to accelerate remediation of the aquifer, and so meet remediation goals in a reasonable period of time. Lifetime project costs would be reduced. Accelerated remediation would insure that the milestone for completing groundwater remediation by year 2018 would be met.

Functional Performance Requirements: The remedial action objectives per the interim ROD and technology application are to reduce uranium concentrations to 480 µg/L. Although the final ROD has not been issued and thus final remediation action objectives have not been established, the functional requirements can be expected to be the same in either case: removal or stabilization of uranium mass.

Work Breakdown Structure (WBS) No.: 1.4.03.3.1.02.08.16

TIP No.: N/A

Relevant PBS Milestone: PBS -MC-029

Justification For Need:

Technical: Stabilization or enhanced uranium removal would the accelerate the remediation effort, reduce the overall time for remediation, and provide technical input into the final ROD.

Regulatory: Given the tendency of uranium to sorb to soils, it is questionable if the current P&T cleanup operation is capable of meeting the remediation goal of restoring the aquifer by year 2018.

Environmental Safety & Health: Accelerating the rate of remediation reduces the potential time that workers would be exposed to contamination. It potentially reduces the amount of radioactive waste that would be produced during the life of the project by minimizing remediation time.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$5M. This estimate is based on an assumed savings of 0.5% of the total Hanford groundwater management life-cycle cost of \$1.2B.

Cultural/Stakeholder Concerns: Cultural/stakeholders are concerned about movement of radioactive contamination off the Hanford Site to the Columbia River, and restoring beneficial use of the land to the public. Continued spreading or enlargement of the plume in the groundwater beyond the 200 West Area is not acceptable.

Other: Early closeout of this effort releases money for other remediation work, and gains public approval and confidence that progress is being made in restoring Hanford groundwater to beneficial use.

Current Baseline Technology: Uranium contaminated groundwater is pumped from a single extraction well, treated in combination with other groundwater contaminants at the Effluent Treatment Facility (ETF) in 200 West, and then disposed at the State Approved Land Disposal Site (SALDS) north of 200 West. The system removes approximately 20 kg/yr of uranium from the aquifer. The average concentration of uranium in the extracted water was 208 µg/L in FY99.

Cost: The cost to operate the pump & treat is approximately \$95K/year. A rough estimate for length of time the current pump & treat system must operate in order to reduce uranium in the groundwater below the action limit is 15 years. Under this scenario, with inflation, the life-cycle cost of the pump and treat system is \$6.2M, including compliance and performance monitoring.

Waste: Besides the treated groundwater that is disposed at the SALDS, other wastes generated and associated with the treatment process include power waste (474 drums), process/groundwater contacted (7 drums, 2 boxes), groundwater regulated (4 drums), and sludge (225 drums) have been produced from 3 years of waste going to the ETF.

How Long It Will Take: Remediation with pump and treat may take another 15 years of operation, based on current qualitative rates of remediation (although no official calculations have been reported). After 6 years of operation, the interior plume concentrations are still 10X the MCL in multiple wells and over 130X the MCL of 20 µg/L in the most contaminated well. The rate of remediation will slow as concentrations decrease.

End-User: Richland Environmental Restoration Project

Site Technical Points-of-Contact: Scott W. Petersen, BHL, (509) 376-8517; Jared D. Isaacs, BHL, (509) 372-9162; Garrett A. Day, BHL, (509) 372-9571; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Points-of-Contact: Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson DOE, (509) 373-0750

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE HANDLING DURING EXCAVATION OF TRU AND HIGH DOSE MATERIALS FROM BURIAL GROUNDS

Identification No.: RL-SS48

Date: March 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit (s): 300-FF-2

PBS No.: RL-RS01 (RL-ER03)

Waste Stream: (Disposition Map Designation: T3-ER [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Remote Handling During Excavation Of TRU And High Dose Materials From Burial Grounds

Need/Opportunity Category: Technology Need

Need Description: Remote handling technologies are needed for removing high dose rate or remote-handled TRU material from burial grounds. Technologies for remote handling material of variable shape and size is needed. Additionally, remote handling technologies are needed for materials in subsurface structures such as caissons or constructed waste units. This need is focused on excavating materials for placement in waste processing areas within the AOC of the burial ground operations.

Schedule Requirements:

Earliest Date Required: 9/30/04

Latest Date Required: 9/30/12

Remedial design for the burial grounds is scheduled to begin in 2005.

Problem Description: This need pertains to two burial grounds located north of Hanford’s 300 Area. A summary of the construction and waste contents for each burial ground are described below.

618-10 Burial Ground

The 618-10 burial ground is approximately 148 m by 143 m (485 ft by 470 ft) oriented northwest by southeast and consists of 12 trenches and 94 vertical pipe units. The vertical pipe units were constructed from six 208-L (55-gallon) drums welded together end-to-end. The trenches were

constructed with dimensions ranging from 15 m to 98 m (50 ft to 320 ft) in length and 12 m to 21 m (40 ft to 70 ft) in width; depth of the trenches was 7.6 m (25 ft). The burial ground has been stabilized with a cover of clean fill.

The 618-10 burial ground received high-level, low-level, and TRU waste. Until 1960 some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in concrete-filled 208-L (55-gallon) drums. After 1960, the high-level waste was packaged in "milk pail" disposal cans and interred in the vertical pipe units. Total TRU estimate for the 618-10 site is one to two kg dispersed throughout the site. During stabilization activities at the site in 1983, a quantity of oil appeared on the surface after heavy equipment drove over a portion of the site.

618-11 Burial Ground

The 618-11 burial ground is approximately 114 m by 305 m (375 ft by 1000 ft) oriented east-west and consists 3 trenches, 50 vertical pipe units (constructed from six 208-L (55-gallon) drums welded together end-to-end), and five 2.4-m- (8-ft) diameter caissons (constructed from 3-m (10-foot) lengths of eight-gauge corrugated steel pipe). The trenches were 274 m (900 ft) long and 15 m (50 ft wide); depth of the trenches was 7.6 m (25 ft). The burial ground has been stabilized with a cover of clean fill.

The 618-11 burial ground received high-level, low-level, and TRU waste. As in the 618-10 burial ground, some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in the vertical pipe units and, after June 1964, in the caissons. Waste materials in vertical pipe units and caissons may be packed inside cans of various sizes (e.g., 1-L, 19-L, 57-L [quart, 5-gallon, 15 gallon]). Some TRU waste was encased in concrete for disposal to burial ground trenches. Total TRU estimate for the 618-11 site is five to ten kg dispersed throughout the site.

Chemical species in the burial grounds may include solid metallic sodium, beryllium residues, contaminated lead shielding, technetium oxide, promethium oxide, zirconium cladding, potentially pyrophoric metal turnings, thorium oxide, other thorium compounds, and uranium compounds. Radioactive isotopes may include ^{14}C , ^{60}Co , ^{65}Zn , ^{90}Sr , ^{103}Ru , ^{131}I , ^{137}Cs , ^{144}Ce , ^{147}Pm , ^{226}Ra , ^{232}Th , ^{233}U , ^{235}U , ^{237}Np , ^{238}U , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Am , and ^{244}Cm .

Additional information about the wastes in the 618-10/11 burial grounds is described in "Characterization of the 618-11 Solid Waste Burial Ground, Disposed Waste, and Description of the Waste-Generating Facilities", 1997, Waste Management Federal Services, Richland, WA, HNF-EP-0649, Rev 0.

It is anticipated that burial ground remediation will be implemented through the following major steps.

- Delineation of burial-ground boundaries
- Pre-excavation waste identification for site excavation planning
- Excavation, characterization & segregation - technologies will be needed for remote handling, field characterization, environmental controls, and waste segregation during excavation operations to minimize worker exposure and environmental hazards
- Waste handling and transport – technologies will be needed for characterization, segregation, and packaging of the excavated waste in a form suitable for transport away from the burial ground area
- Final disposal

Benefit to the Project Baseline of Filling Need: As identified in the Technology Alternatives Baseline document for the 618-10/11 burial grounds (BHI-01484, <http://www.bhi->

erc.com/library/bhi/bhi01484.pdf), there are currently technology gaps associated with appropriate remote handling technologies for burial ground excavation, particularly the caissons and vertical pipe units. Development of suitable technologies is needed as part of identifying the most effective technical approach for burial ground remediation.

Functional Performance Requirements: The technology must be able to operate in a burial ground environment. Technologies are needed that can remotely retrieve boxed waste, debris of variable size and shape, and contaminated soils. Technologies are also needed that can access and retrieve waste in caissons through a 0.9-m (3-ft) diameter offset chute and access and retrieve waste in the vertical pipe units described in the Problem Description.

Work Breakdown Structure (WBS) No. : 1.4.03.2.1 (RL-RS01)

TIP No.: TIP 0003

Relevant PBS Milestone: PBS-MC-028, M-16-00B

Justification For Need:

Technical: The Technology Alternatives Baseline document prepared for the 618-10/11 burial grounds determined that there are no developed technologies currently available for remote handling during excavation of high dose rate and TRU materials in burial ground environments.

Regulatory: Environmental regulations are relevant to the need for excavating the burial ground, but do not specifically require use of remote handling techniques.

Environmental Safety & Health: Worker safety and requirements for handling high dose rate and TRU materials are the primary reasons for the stated need for remote handling technologies.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:
This need is for an enabling technology with a primary benefit of reducing worker risk.

Cultural/Stakeholder Concerns: The primary concern related to this need is ensuring the safety of workers, the public, and the environment during burial ground remediation operations.

Other: None

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Richard A. Carlson, BHI, (509) 372-9632; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Vern R. Dronen, BHI, (509) 372-9075

DOE End-User/Representative Point-of-Contact: Robert G. McLeod DOE, (509) 372-0096

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTAMINATION CONTROL DURING EXCAVATION ACTIVITIES

Identification No.: RL-SS49

Date: March 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit (s): 300-FF-2

PBS No.: RL-RS01 (RL-ER03)

Waste Stream: (Disposition Map Designation: T3-ER [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Contamination control during excavation activities

Need/Opportunity Category: Technology Need

Need Description: Technologies are needed to control the physical dispersion of TRU and high dose rate contaminated material and to provide appropriate shielding of radiation from these materials during all phases of burial ground excavation.

Schedule Requirements:

Earliest Date Required: 9/30/04

Latest Date Required: 9/30/12

Remedial design for the burial grounds is scheduled to begin in 2005.

Problem Description:

This need pertains to two burial grounds located north of Hanford’s 300 Area. A summary of the construction and waste contents for each burial ground are described below.

618-10 Burial Ground

The 618-10 burial ground is approximately 148 m by 143 m (485 ft by 470 ft) oriented northwest by southeast and consists of 12 trenches and 94 vertical pipe units. The vertical pipe units were constructed from six 208-L (55-gallon) drums welded together end-to-end. The trenches were constructed with dimensions ranging from 15 m to 98 m (50 ft to 320 ft) in length and 12 m to 21 m (40 ft to 70 ft) in width; depth of the trenches was 7.6 m (25 ft). The burial ground has been stabilized with a cover of clean fill.

The 618-10 burial ground received high-level, low-level, and TRU waste. Until 1960 some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in concrete-filled 208-L (55-gallon) drums. After 1960, the high-level waste was packaged in “milk pail” disposal cans and interred in the vertical pipe units. Total TRU estimate for the 618-10 site is one to two kg dispersed throughout the site. During stabilization activities at the site in 1983, a quantity of oil appeared on the surface after heavy equipment drove over a portion of the site.

618-11 Burial Ground

The 618-11 burial ground is approximately 114 m by 305 m (375 ft by 1000 ft) oriented east-west and consists 3 trenches, 50 vertical pipe units (constructed from six 208-L (55-gallon) drums welded together end-to-end), and five 2.4-m- (8-ft) diameter caissons (constructed from 3-m (10-foot) lengths of eight-gauge corrugated steel pipe). The trenches were 274 m (900 ft) long and 15 m (50 ft wide); depth of the trenches was 7.6 m (25 ft). The burial ground has been stabilized with a cover of clean fill.

The 618-11 burial ground received high-level, low-level, and TRU waste. As in the 618-10 burial ground, some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in the vertical pipe units and, after June 1964, in the caissons. Waste materials in vertical pipe units and caissons may be packed inside cans of various sizes (e.g., 1-L, 19-L, 57-L [quart, 5-gallon, 15 gallon]). Some TRU waste was encased in concrete for disposal to burial ground trenches. Total TRU estimate for the 618-11 site is five to ten kg dispersed throughout the site.

Chemical species in the burial grounds may include solid metallic sodium, beryllium residues, contaminated lead shielding, technetium oxide, promethium oxide, zirconium cladding, potentially pyrophoric metal turnings, thorium oxide, other thorium compounds, and uranium compounds. Radioactive isotopes may include ^{14}C , ^{60}Co , ^{65}Zn , ^{90}Sr , ^{103}Ru , ^{131}I , ^{137}Cs , ^{144}Ce , ^{147}Pm , ^{226}Ra , ^{232}Th , ^{233}U , ^{235}U , ^{237}Np , ^{238}U , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Am , and ^{244}Cm .

Additional information about the wastes in the 618-10/11 burial grounds is described in “Characterization of the 618-11 Solid Waste Burial Ground, Disposed Waste, and Description of the Waste-Generating Facilities”, 1997, Waste Management Federal Services, Richland, WA, HNF-EP-0649, Rev 0.

It is anticipated that burial ground remediation will be implemented through the following major steps.

- Delineation of burial-ground boundaries
- Pre-excavation waste identification for site excavation planning
- Excavation, characterization & segregation - technologies will be needed for remote handling, field characterization, environmental controls, and waste segregation during excavation operations to minimize worker exposure and environmental hazards
- Waste handling and transport – technologies will be needed for characterization, segregation, and packaging of the excavated waste in a form suitable for transport away from the burial ground area
- Final disposal

Benefit to the Project Baseline of Filling Need: As identified in the Technology Alternatives Baseline document for the 618-10/11 burial grounds (BHI-01484, <http://www.bhi-erc.com/library/bhi/bhi01484.pdf>), there are currently technology gaps associated with appropriate technologies for controlling the spread of contamination and shielding radiation during excavation of the type of materials expected in the 618-10/11 burial grounds. Development of suitable technologies is needed as part of identifying the most effective technical approach for burial ground remediation.

Functional Performance Requirements: The technology must be able to operate in a burial ground environment. Technologies are needed that can provide physical containment and shielding during retrieval of boxed waste (potentially damaged), debris of variable size and shape, and contaminated soils. Technologies are also needed that can provide containment and shielding during retrieval of waste in caissons and from the vertical pipe units described in the Problem Description.

Work Breakdown Structure (WBS) No. : 1.4.03.2.1 (RL-RS01)

TIP No.: TIP 0003

Relevant PBS Milestone: PBS-MC-028, M-16-00B

Justification For Need:

Technical: The Technology Alternative Baseline document prepared for the 618-10/11 burial grounds identified that technologies directly suitable for physical containment and shielding during excavation of high dose rate and TRU materials in burial ground environments were not available.

Regulatory: Washington State air regulations will require controls to minimize the release of radionuclides into the environment.

Environmental Safety & Health: Worker safety and requirements for handling high dose rate and TRU materials are primary reasons for the stated need for containment and shielding technologies.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:
This need is for an enabling technology with a primary benefit of reducing worker risk.

Cultural/Stakeholder Concerns: The primary concern related to this need is ensuring the safety of workers, the public, and the environment during burial ground remediation operations.

Other: None

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Richard A. Carlson, BHI, (509) 372-9632; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Vern R. Dronen, BHI, (509) 372-9075

DOE End-User/Representative Point-of-Contact: Robert G. McLeod DOE, (509) 372-0096

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

WASTE SEGREGATION AND PACKAGING FOR TRU AND HIGH DOSE RATE CONTAMINATED MATERIAL

Identification No.: RL-SS50

Date: March 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit (s): 300-FF-2

PBS No.: RL-RS01 (RL-ER03)

Waste Stream: (Disposition Map Designation: T3-ER [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Waste segregation and packaging for TRU and high dose rate contaminated material

Need/Opportunity Category: Technology Need

Need Description: Technologies are needed to segregate contaminated material retrieved from the burial grounds based on waste designation, and package each material appropriately for transportation away from the burial ground. Techniques need to include appropriate characterization to segregate waste for packaging according to the criteria for final disposition (e.g., waste acceptance criteria). The technologies must provide or be compatible with remote handling techniques to perform segregation and packaging of contaminated material. Additionally, the technology must provide or be compatible with techniques for environmental control (spreading and shielding) of contaminated material.

Schedule Requirements:

Earliest Date Required: 9/30/04

Latest Date Required: 9/30/12

Remedial design for the burial grounds is scheduled to begin in 2005.

Problem Description: This need pertains to two burial grounds located north of Hanford’s 300 Area. A summary of the construction and waste contents for each burial ground are described below.

618-10 Burial Ground

The 618-10 burial ground is approximately 148 m by 143 m (485 ft by 470 ft) oriented northwest by southeast and consists of 12 trenches and 94 vertical pipe units. The vertical pipe units were constructed from six 208-L (55-gallon) drums welded together end-to-end. The trenches were constructed with dimensions ranging from 15 m to 98 m (50 ft to 320 ft) in length and 12 m to 21 m (40 ft to 70 ft) in width; depth of the trenches was 7.6 m (25 ft). The burial ground has been stabilized with a cover of clean fill.

The 618-10 burial ground received high-level, low-level, and TRU waste. Until 1960 some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in concrete-filled 208-L (55-gallon) drums. After 1960, the high-level waste was packaged in "milk pail" disposal cans and interred in the vertical pipe units. Total TRU estimate for the 618-10 site is one to two kg dispersed throughout the site. During stabilization activities at the site in 1983, a quantity of oil appeared on the surface after heavy equipment drove over a portion of the site.

618-11 Burial Ground

The 618-11 burial ground is approximately 114 m by 305 m (375 ft by 1000 ft) oriented east-west and consists 3 trenches, 50 vertical pipe units (constructed from six 208-L (55-gallon) drums welded together end-to-end), and five 2.4-m- (8-ft) diameter caissons (constructed from 3-m (10-foot) lengths of eight-gauge corrugated steel pipe). The trenches were 274 m (900 ft) long and 15 m (50 ft wide); depth of the trenches was 7.6 m (25 ft). The burial ground has been stabilized with a cover of clean fill.

The 618-11 burial ground received high-level, low-level, and TRU waste. As in the 618-10 burial ground, some high-level and TRU wastes were disposed of in cardboard containers with contact doses up to 500 R/h, although most high-level waste was interred in the vertical pipe units and, after June 1964, in the caissons. Waste materials in vertical pipe units and caissons may be packed inside cans of various sizes (e.g., 1-L, 19-L, 57-L [quart, 5-gallon, 15 gallon]). Some TRU waste was encased in concrete for disposal to burial ground trenches. Total TRU estimate for the 618-11 site is five to ten kg dispersed throughout the site.

Chemical species in the burial grounds may include solid metallic sodium, beryllium residues, contaminated lead shielding, technetium oxide, promethium oxide, zirconium cladding, potentially pyrophoric metal turnings, thorium oxide, other thorium compounds, and uranium compounds. Radioactive isotopes may include ^{14}C , ^{60}Co , ^{65}Zn , ^{90}Sr , ^{103}Ru , ^{131}I , ^{137}Cs , ^{144}Ce , ^{147}Pm , ^{226}Ra , ^{232}Th , ^{233}U , ^{235}U , ^{237}Np , ^{238}U , ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Am , and ^{244}Cm .

Additional information about the wastes in the 618-10/11 burial grounds is described in "Characterization of the 618-11 Solid Waste Burial Ground, Disposed Waste, and Description of the Waste-Generating Facilities", 1997, Waste Management Federal Services, Richland, WA, HNF-EP-0649, Rev 0.

It is anticipated that burial ground remediation will be implemented through the following major steps.

- Delineation of burial-ground boundaries
- Pre-excavation waste identification for site excavation planning
- Excavation, characterization & segregation - technologies will be needed for remote handling, field characterization, environmental controls, and waste segregation during excavation operations to minimize worker exposure and environmental hazards
- Waste handling and transport – technologies will be needed for characterization, segregation, and packaging of the excavated waste in a form suitable for transport away from the burial ground area

- Final disposal

Benefit to the Project Baseline of Filling Need: As identified in the Technology Alternatives Baseline document for the 618-10/11 burial grounds (BHI-01484, <http://www.bhi-erc.com/library/bhi/bhi01484.pdf>), there are currently technology gaps associated with appropriate waste handling and packaging technologies for materials retrieved from the 618-10/11 burial grounds. Development of suitable technologies is needed as part of identifying the most effective technical approach for burial ground remediation.

Functional Performance Requirements: The technology must be able to operate in a burial ground environment. Technologies are needed that can segregate and package waste including boxed waste (potentially damaged), debris of variable size and shape, and contaminated soils. Technologies are also needed that can segregate and package waste from the caissons and from the vertical pipe units described in the Problem Description. The technology must provide or be compatible with techniques for physical containment and shielding of the waste. The technologies must also provide appropriate characterization to determine waste designation for packaging according to waste acceptance criteria for final disposition (e.g., WIPP).

Work Breakdown Structure (WBS) No. : 1.4.03.2.1 (RL-RS01)

TIP No.: TIP 0003

Relevant PBS Milestone: PBS-MC-028, M-16-00B

Justification For Need:

Technical: The Technology Alternatives Baseline document prepared for the 618-10/11 burial grounds identified that technologies directly suitable for waste handling and packaging during excavation of high dose rate and TRU materials in burial ground environments were not available.

Regulatory: Transportation requirements and Waste Acceptance Criteria at disposal sites will require specific waste handling and packaging for TRU and high dose rate material.

Environmental Safety & Health: Worker safety and requirements for handling high dose rate and TRU materials will require specific waste handling and packaging for TRU and high dose rate material.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:
This need is for an enabling technology with a primary benefit of reducing worker risk.

Cultural/Stakeholder Concerns: The primary concern related to this need is ensuring the safety of workers, the public, and the environment during burial ground remediation operations.

Other: None

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Richard A. Carlson, BHI, (509) 372-9632; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Vern R. Dronen, BHI, (509) 372-9075

DOE End-User/Representative Point-of-Contact: Robert G. McLeod DOE, (509) 372-0096

SUBSURFACE CONTAMINANTS

Vadose Zone

INTEGRATED NEEDS FOR GROUNDWATER/VADOSE ZONE INTEGRATION PROJECT – FY02

The Groundwater/Vadose Zone Integration Project (Integration Project) worked with the core projects in FY99 to prepare Integrated Needs for those needs associated with the characterization and assessment of the contaminant inventory, vadose zone, groundwater, and river systems. In FY00, a similar process was used to develop 4 additional Integrated Needs for risk assessment and to make minor revisions to the needs developed in FY99. These needs were updated in FY01 and in FY02. The Integrated Needs reflect the roadmap scope and collect the Science and Technology (S&T) needs prepared by the core projects and the Integration Project into 19 types of needs.

ERC NEED STATEMENTS ASSOCIATED WITH HANFORD'S GROUNDWATER/VADOSE ZONE INTEGRATION PROJECT

Hanford's Integration Project (Integration Project) divides its work into eight technical elements. In addition to these technical elements, a System Assessment Capability is being developed by the Integration Project as the means to coordinate and collectively analyze the information from the other technical elements. The eight technical elements are:

- Vadose Zone
- Groundwater
- River
- Inventory
- Risk
- Monitoring
- Regulatory Path
- Remediation Options.

Of the eight technical elements that are part of the Integration Project, four of the elements highlighted in the bullets above (Vadose Zone, Groundwater, River, and Inventory) were addressed in detail in Rev. 0 the Integration Project Roadmap (DOE/RL-98-48). In FY00, the project added a detailed description of the Risk technical element within the update of the Integration Project S&T Roadmap (Rev. 1). The FY02 needs associated with the Integration Project remain essentially unchanged and continue to be aligned with the technical content of these five technical elements. Some of the technology needs and science needs being carried forward to FY02 align with the Remediation Options technical element because the scope of this technical element includes the current remedial actions of the Environmental Restoration Contractor (ERC). Additional detail on the Remediation technical elements will be added during FY02 as the Integration Project updates the S&T roadmap to Rev. 2. In addition to adding the remediation technical element, the roadmap will be updated to address comments by the National Research Council/National Academy of Sciences committee that recently completed its review of the Integration Project S&T as well as initial results of the System Assessment Capability. The S&T needs statements will be revised during FY02 update of the roadmap. The Monitoring technical element is currently planned for inclusion in Rev. 3 of the S&T roadmap during FY03.

Table 1 lists the FY 2002 needs (in bold type) and detailed needs as they relate to the technical elements of the Integration Project. Needs related to the other technical elements will be added later after the roadmapping process is completed in FY02. The Integration Project needs are grouped by the technical element to which they align as shown in the Table 1.

Table 1. Integration Project Technical Elements and Corresponding Hanford Needs.

Vadose Zone	Groundwater	River	Inventory	Risk	Remediation Options
RL-SS27	RL-SS32	RL-SS36	RL-SS40	RL-SS43	RL-SS01
RL-SS28	RL-SS03	RL-SS37	RL-WT01	RL-SS44	RL-SS02
RL-SS23-S	RL-SS06	RL-SS38	RL-WT070	RL-SS45	RL-SS03
RL-SS24-S	RL-SS33	RL-SS39	RL-WT090	RL-SS46	RL-SS04
RL-SS26-S	RL-SS25		RL-WT091		RL-SS05
RL-SS27-S	RL-SS34		RL-SS42		RL-SS06
RL-SS30-S	RL-SS23-S		RL-WT068		RL-SS07
RL-WT035-S	RL-SS24-S				RL-SS08
RL-WT053-S	RL-SS25-S				RL-SS09
RL-SS29	RL-SS26-S				RL-SS10
RL-SS28-S	RL-SS27-S				RL-SS11
RL-SS29-S	RL-SS28-S				RL-SS12
RL-SS31-S	RL-SS31-S				RL-SS13
RL-SS35-S	RL-SS32-S				RL-SS14
RL-WT053-S	RL-SS35-S				RL-SS15
RL-WT044-S	RL-SS35				RL-SS16
RL-SS30					RL-SS17
RL-WT044-S					RL-SS18
RL-WT035-S					RL-SS19
RL-SS31					RL-SS20
RL-SS25-S					RL-SS23
RL-SS37-S					RL-SS24
RL-SS25					RL-SS25
RL-SS26					RL-SS26
RL-WT102					RL-WT017
RL-WT026					RL-WT018
					RL-WT061
					RL-SS33-S
					RL-SS34-S
					RL-SS36-S
					RL-WT046-S

Vadose Zone Element Index to Linked Needs.

RL-SS27	Use of Field Data from Representative Sites to Elucidate Controlling Features and Processes for Contaminant Distribution
RL-SS28	Understand, Quantify and Develop Descriptions of Reactions and Interactions between Contaminants of Concern and Vadose Zone Sediments
RL-SS23-S	Chemical Speciation and Complexation in Site-Specific Groundwaters
RL-SS24-S	Chemical Binding on Site-Specific Mineral Surfaces
RL-SS26-S	Reaction Rates for Key Contaminant Species and complexes in Site-Specific Groundwaters
RL-SS27-S	Rates of Coupled Abiotic and biogeochemical Reactions Involving Contaminants in Hanford Subsurface
RL-SS30-S	Remedial Technology for Cs Beneath Waste Tanks
RL-WT035-S	Moisture Flow and contaminant Transport in Arid Conditions
RL-WT053-S	Contaminant Mobility Beneath Tank Farms
RL-SS29	Develop Descriptions of Contaminant Flow and Transport in the Vadose Zone
RL-SS28-S	Rates of Colloid Formation and Colloidal Transport of Contaminants in Site-Specific Groundwaters
RL-SS29-S	Effect of Subsurface Heterogeneities on Chemical Reaction and Transport
RL-SS31-S	Mathematical Formulations of Chemical Reaction/Material Transport
RL-SS35-S	Use of Chemical surrogates for Contaminants
RL-WT053-S	Contaminant Mobility Beneath Tank Farms
RL-WT044-S	Distribution of Recharge Rates
RL-SS30	Understand and Quantify Water Movement in the Vadose Zone Using Uncontaminated Field Sites
RL-WT044-S	Distribution of Recharge Rates
RL-WT035-S	Moisture Flow and contaminant Transport in Arid Conditions
RL-SS31	Provide Advanced Characterization Tools and Methods to Delineate Contaminant Plumes in the Vadose Zone and Relate Plume Distribution of Geochemical and Hydrogeological Properties
RL-SS25-S	Chemical Form and Mobility of Dense, Non-Aqueous Phase Liquids in Hanford Subsurface Transport of Contaminants
RL-SS37-S	Chemical Sensor Principles
RL-SS25	Improved, Cost-Effective Methods for Sub-Surface Access to Support Characterization and Remediation
RL-SS26	Improved Methods for Determining Distribution of Beta Emitting Contaminants in Subsurface Soils
RL-WT026	Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)
RL-WT102	Advanced Characterization Tools for Contaminants of Concern

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

USE OF FIELD DATA FROM REPRESENTATIVE SITES TO ELUCIDATE CONTROLLING FEATURES AND PROCESSES FOR CONTAMINANT DISTRIBUTION

Identification No.: RL-SS27

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Use of field data from representative sites to elucidate controlling features and processes for contaminant distribution.

Need Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site Science and Technology Coordination Group (STCG) Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Currently, information on contaminant distribution, physical association, and chemical form in the vadose zone beneath waste sites of different source terms, ages, and water flow histories (e.g., cribs, tanks, trenches, spills, etc.) is not adequate to forecast whether future breakthrough to groundwater will occur (see for example, Hodges, 1998; Johnson and Chou, 1998; Narbutovskih, 1998). For example, prior to

recent efforts by the River Protection Project (RPP) Tank Farm Vadose Zone Project to characterize the S-SX and B, BX-BY tank farms, only two cores have been collected beneath leaked single shell waste tanks (Freeman-Pollard et al., 1994; Myers et al., 1998), and debate exists as to whether the retrieved samples were or were not compromised. Moreover, little is known about the physical and chemical processes that are most significant over protracted contact times of the waste with the sediments in the vadose zone (Jones et al., 1998). These processes may differ significantly from short term ones studied in the laboratory. Within this context, the effects of extreme waste chemistry, unsaturated water conditions and complex, geologically controlled water flow paths add to the uncertainty of contaminant movement (Conaway et al., 1997; Conaway et al., 1998). Without such information, little can be said about the long-term stability of the in-ground contaminant inventory; has it been immobilized or is it available for transport?

Hence, there is a need to investigate select field sites that are representative of major Hanford waste and disposal scenarios to develop rigorous conceptual models of governing processes for use in remediation and closure characterization assessment and performance validation. The development of conceptual models requires field sampling and study to understand 1) how contamination is distributed in the vadose zone beneath different types of waste sites with different source chemistries and different release histories, 2) the physical and chemical processes responsible for such distribution, and 3) whether contaminants have been immobilized or are still labile and migrating. The relationship between the contaminant distribution, moisture content, and the physical, chemical, microbiological, and geological characteristics of the subsurface sediments is needed as part of such an assessment. Critical information needs include the mineralogic association of contaminants, their mode of chemical binding, and interparticle location; presence of co-contaminants; and the physical/pore structure of the sediments that may imply the geochemical and hydrologic means of emplacement.

The elucidation of processes, lability, and current migration requires carefully formulated scientific characterization of field core samples that is closely linked with laboratory experimentation (e.g., contaminant desorption rates) to define key physical, chemical, and biologic aspects of the contaminant associations. Multiple core sampling at different times may be needed at a given site to assess migration. Rationalizing the existing contaminant distribution and forecasting future migration requires that water flow processes within the vadose zone at representative sites be characterized and understood (at least qualitatively), particularly those induced by preferential flow paths, high-density waste solutions, and/or other channeling effects. The primary technical gaps associated with the development of rigorous conceptual models of different waste sites and scenarios at Hanford are:

- The long-term geochemical reactions responsible for in-ground contaminant retardation and mobilization are insufficiently understood to predict when and where they have/will occur and their magnitude and direction. Defining these for different contaminants, waste types, release histories and water volumes will provide chemical information to drive improved performance assessment models that include chemical reaction and insights to assess the migration potential of in-ground contaminants.
- Water flow pathways as driven by in-situ geologic features in the vadose zone and waste properties such as temperature, electrolyte identity and composition, and density are insufficiently defined to estimate where waste solutions will migrate, the depth of their penetration, and sediment properties in which they will reside. An improved understanding of these in-situ pathways beneath existing sites and their controlling features will provide necessary models and insights that can be extrapolated to other sites at Hanford for prediction of where waste fluids are likely to migrate, their extent of dilution, and the possibility and timing of their breakthrough to groundwater.

Hydrochemical effects of waste-sediment interaction such as porosity enhancement from mineral dissolution, pore-plugging from precipitation of waste constituents such as aluminum, clay dispersion, or colloid generation have been insufficiently investigated to estimate when and where they will occur and their net effect on water and contaminant migration. Information on these linked chemical-hydrologic effects will provide key insights on the rates and direction of waste migration beneath single shell tanks and the possibility that they may reach groundwater.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, December 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with enhanced conceptual models for processes in the vadose zone is needed in the FY 2002 to FY 2005 timeframe to meet these objectives.

Problem Description: This need falls under the Vadose Zone Technical Element within the S&T Endeavor. The Vadose Zone Technical Element is intended to address and resolve scientific problems related to the leakage of radioactive and hazardous wastes into Hanford soils and sediments. The objective of the Vadose Zone Technical Element is to enhance protection of human health and the environment by providing 1) improved models, measurements, and data to predict contaminant migration and provide warning of potential surface or groundwater contamination before problems arise; 2) scientific rigor to system assessment and performance assessment (PA) models as they are developed, reviewed, and implemented; and 3) scientific support for selection of the most safe, efficient, and effective remedial actions and site closure activities. An implicit goal of this research is to provide scientific and regulatory credibility to the U.S. Department of Energy's (DOE's) environmental management decision-making process.

The scope of this technical element encompasses the unsaturated zone beneath the Hanford Site. The geographic focus is on areas that (1) underlie liquid waste disposal sites; (2) have the potential for leaks or leaching; and (3) have experienced past leaks and spills. Also included are selected areas away from the focus areas, such as areas representative of background conditions, and areas that have the potential to become contaminated in the future. The primary suite of contaminants to be investigated include: ^{137}Cs , ^{90}Sr , ^{60}Co , $^{235/238}\text{U}$, ^{99}Tc , $^{239/240}\text{Pu}$, ^{237}Np , ^{241}Am , ^{129}I , CCl_4 and CrO_4^{2-} , but others, including co-contaminants (Na^+ , NO_3^-) and indigenous ions (Ca^{2+} , Mg^{2+}) may be included as necessary depending on the nature of the specific sites studied.

Specific topics for this need include in order of expected implementation (1) collaboration with River Protection Program (RPP) in current and planned tank farm field investigations (e.g B, BX-BY and T, TX-TY); (2) quantification of the variations in recharge rates at existing waste sites (200-BP-1, etc.) of interest and assessment of these variations on contaminant migration rates; (3) studies of dense non-aqueous phase liquids (DNAPLs) (CCl_4) distribution and migration in 200 West; and (4) selective high-impact collaborations with other site characterization efforts at cribs, ponds, and dry waste sites to be investigated as part of the 200, 300, and 100 Area environmental restoration efforts.

Benefit to the Project Baseline of Filling Need: The application of surface barriers and other remediation strategies currently planned for the Hanford Site depends on improved measurements of transport processes in the vadose zone. Confidence in predicting contaminant travel times at treated or covered sites will be enhanced by implementing this activity. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must delineate associations between physical, chemical, microbiological, and geological characteristics such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. 1.4.03.4.4

TIP No.: TIP-0011

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: Currently, information on physical association and chemical form of important contaminants in the vadose zone beneath waste sites of different source terms, ages, and water flow histories (e.g., cribs, tanks, trenches, spills, etc.) is not adequate to explain distribution of contaminants in the vadose zone today or to forecast future likely distribution. Little is known about the physical and chemical processes that are most significant over protracted contact times of the waste with the sediments in the vadose zone. Within this context, the effects of extreme waste chemistry, unsaturated water conditions and complex, geologically controlled water flow paths add to the uncertainty of contaminant movement.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety and Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the *Columbia River Comprehensive Impact Assessment* (CRCIA) Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

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Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND, QUANTIFY AND DEVELOP DESCRIPTIONS OF REACTIONS AND INTERACTIONS BETWEEN CONTAMINANTS OF CONCERN AND VADOSE ZONE SEDIMENTS

Identification No.: RL-SS28

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- ___ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ___ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Field data provides insight on the processes controlling the flux of key risk drivers and inventory elements to the groundwater. Quantification of these processes, and the bio- and hydrochemical reactions that contribute to them (e.g. adsorption, mineral precipitation and dissolution, and biomineralization, matrix diffusion, pore plugging, and colloid formation) is ultimately required to defensibly forecast

migration velocity, concentration, and breakthrough as needed for remediation assessment. Complications such as the impact of extreme waste conditions (e.g., high acidity, basicity, ionic strength), preferential water flow with implications to reactive surface area and waste/sediment ratios, geochemical reaction in thin water films present under unsaturated conditions, the effects of solvents, complexants, and mobile colloids on radionuclide mobility (e.g., Pu), and the resuscitation and biogeochemical impact of microorganisms under conditions of artificial recharge are all significant in the Hanford vadose zone and measurements and study are needed to define and quantify their impact. An understanding of whether contaminants become more or less mobile with protracted contact times as well as the direction of change (e.g., greater or lesser mobility); and physical, chemical, and biological causes of such changes and how they are appropriately modeled are needed.

It is important to note that many laboratory studies have been performed on the interactions of contaminants with Hanford sediments from different actual and simulated waste matrices (see for example Serne et al., 1993; Kaplan and Serne, 1995; Kaplan et al., 1996). These studies have defined empirical relationships between sorption parameters (e.g., K_d) sediment properties, and competitive ions (e.g., Ca^{2+} , Na^+) for some contaminants (e.g., ^{137}Cs , ^{90}Sr), and have defined expected ranges in K_d for others (e.g., Pu, Tc, Cr, U, Np, I). Such studies have also provided insights on the qualitative nature of retardation mechanisms (e.g., precipitation, ion exchange), and the potential impacts of extreme waste chemistry (Kaplan et al., 1998). While these studies have been well performed with the objective of parameterizing performance assessment calculations (e.g., Smoot et al., 1989), they fall short in defining the specifics of the transport process as needed for defensible long-term predictions of migration and in-ground stability. Furthermore, that data and associated understanding are fundamentally empirical, have not well defined the primary reaction processes, and poorly account for such important factors as co-contaminant ions, sediment properties, and reaction rate.

The primary technical gaps associated with reactions and interactions between wastes and vadose zone sediments are that the chemical and biologic reactions and colloidal transport processes responsible for contaminant retardation, immobilization, and mobilization are insufficiently understood or lack data on key parameters to allow for defensible predictions of their in-ground rates, extent, magnitude, and effect. This information is important to resolve important Hanford-specific geochemical questions for key contaminants such as 1) the potential colloid-facilitated transport of plutonium and the facilitating effects of DNAPL and complexants, 2) the existence of geochemical reactions (heterogeneous reduction, inter-particle diffusion) potentially responsible for technetium immobilization in the vadose zone, and 3) the extent of in-ground fixation of sorbed cesium-137 and strontium-90. Specific issues that need to be addressed to resolve these technical gaps include the following.

- New insights and descriptive kinetic and thermodynamic information for reactions and interactions in the vadose zone based on key biogeochemical and hydrochemical reactions that control unsaturated chemical transport through the vadose zone are needed. The information is needed to assist in explaining solute attenuation profiles and chemical/ mineralogical speciation at contaminated sites and in developing improved process-level models for important reaction types, including colloid transport, as well as the hydrogeochemical effects on hydraulic properties and fluid flow. Specific information needed includes the following. Determination of the speciation and complexation of contaminants of interest in an aqueous phase distributed in the vadose zone (pristine and contacted by tank waste liquids) is needed (Science Need RL-SS23-S). Information is needed to understand the reactions that will affect the binding of contaminants in solution on secondary mineral surfaces, and on primary phases (Science Need RL-SS24-S). The reaction rates and the key reaction steps that control the speed with which a contaminant changes chemical form (e.g., speciation, complexation) and/or interacts with the surfaces of secondary minerals need to be quantified (Science Need RL-SS26-S). The reaction rates affecting cesium adsorption on micaceous secondary minerals exposed to chemical conditions similar to those generated by

leaking high-level waste need to be quantified (Science Need RL-SS30-S). An understanding of the effect of coupled abiotic and biogeochemical reactions for which independent rates of reaction are known on contaminant form (e.g. speciation/complexation) is needed (Science Need RL-SS27-S).

- Sufficient scientific information is needed to support defensible simplification of complex contaminant reactions for tractable modeling at both waste site and sitewide scales as required for the sitewide model.
- The impact of extreme waste chemical conditions (high acidity, basicity, ionic strength, DNAPL presence, etc.) on contaminant mobility, the phases with which contaminants associate, hydrologic/geochemical properties and their distribution, and water-flow pathways needs to be determined.
- Information is needed to determine whether contaminants become more or less mobile with protracted contact times. The information should include the direction of change (e.g., greater or lesser mobility) and physical, chemical, and biologic causes of such changes, and how are they appropriately described (modeled).
- Information is needed to understand the relationship between geochemical reactions and hydrogeological properties that affect transport through the vadose zone.
- Information is needed to understand to what extent laboratory-derived reaction parameters are descriptive of geochemical phenomena occurring in preferred flow paths and, if there are differences, what in situ features cause the differences.
- Techniques are needed to characterize surface areas of reacting solids in the field and determine to what extent the mineral surfaces are hydrologically accessible.
- Other existing S&T needs that relate to this need include RL-WT035-S and RL-WT053-S.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, December 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with reactions and interactions between contaminants and vadose zone sediments is needed in the FY02 to FY05 timeframe to meet these objectives.

Problem Description: This need falls under the Vadose Zone Technical Element within the S&T Endeavor. The Vadose Zone Technical Element is intended to address and resolve scientific problems related to the leakage of radioactive and hazardous wastes into Hanford soils and sediments. The objective of the Vadose Zone Technical Element is to enhance protection of human health and the environment by providing 1) improved models, measurements, and data to predict contaminant migration and provide warning of potential surface or groundwater contamination before problems arise; 2) scientific rigor to system assessment and PA models as they are developed, reviewed, and implemented; and 3) scientific support for selection of the most safe, efficient, and effective remedial actions and site closure activities. An implicit goal of this research is to provide scientific and regulatory credibility to DOE's environmental management decision-making process.

The scope of this technical element encompasses the unsaturated zone beneath the Hanford Site. The geographic focus is on areas that (1) underlie liquid waste disposal sites; (2) have the potential for leaks or leaching; and (3) have experienced past leaks and spills. Also included are selected areas away from the focus areas, such as areas representative of background conditions, and areas that have the potential to become contaminated in the future.

Specific topics for this need include (1) new insights and descriptive kinetic and thermodynamic information to assist in explaining solute attenuation profiles and improved process level modeling; (2) constitutive relationships to be used in reactive transport models for history matching of contaminant distribution at representative field sites; and (3) knowledge to support defensible simplification of complex contaminant reactions for tractable modeling at both waste sites and sitewide scales during performance and remediation assessments. The key Hanford contaminants include risk-drivers (^{99}Tc , ^{129}I , CCl_4 , CrO_4^{2-}), major inventory constituents (^{137}Cs , ^{90}Sr , ^{60}Co , $^{235/238}\text{U}$), and other elements of concern ($^{239/240}\text{Pu}$, ^{237}Np , ^{241}Am).

Benefit to the Project Baseline of Filling Need: The application of surface barriers and other remediation strategies currently planned for the Hanford Site depends on improved measurements of transport processes in the vadose zone. Confidence in predicting contaminant travel times at treated or covered sites will be enhanced by implementing this activity. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must describe and quantify reactions and interactions between contaminants of concern and vadose zone sediments such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0011

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: The chemical and biologic reactions and colloidal transport processes responsible for contaminant retardation, immobilization, and mobilization are insufficiently understood or lack data on key parameters to allow for defensible predictions of their in-ground rates, extent, magnitude, and effect. This information is important to resolve important Hanford-specific geochemical questions for key contaminants such as 1) the potential colloid-facilitated transport of plutonium and the facilitating effects of DNAPLs and complexants, 2) the existence of geochemical reactions (heterogeneous reduction, inter-particle diffusion) potentially responsible for technetium immobilization in the vadose zone, and 3) the extent of in-ground fixation of sorbed ^{137}Cs , ^{90}Sr , and CCl_4 .

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DEVELOP DESCRIPTIONS OF CONTAMINANT FLOW AND TRANSPORT IN THE VADOSE ZONE

Identification No.: RL-SS29

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Develop Descriptions of Contaminant Flow and Transport in the Vadose Zone.

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The approach to date has been to use relatively simple models to describe contaminant transport in the vadose zone. These models are “simple” in that they lump many of the complexities into relatively few input parameters. For example, the potentially complex aspects of fluid chemistry and mineralogy are treated with a sorption coefficient and a porosity. The complexities of flow are described with two dispersion coefficients. Soil hydrological properties are allowed to change only with depth. Recharge rates, and consequently flow, are assumed to be constant with time rather than episodic, and coarse

gridding for numerical models tends to smooth the calculated flow and mask the potential creation of fast paths in the real world. The sum of all of these simplifications and approximations is that the resultant calculated contaminant mobility is subject to very large errors. Furthermore, predictions made with these models cannot hold up to critical technical scrutiny, and more importantly, they fail to match observations that have and will be made by monitoring and characterization activities.

Previously employed approaches for modeling vadose zone transport do not capture essential processes that affect contaminant migration at Hanford. Previous modeling efforts have used decoupled approaches even though radionuclide and contaminant transport may involve fully coupled thermal-hydrological-mechanical-chemical processes. In addition, the effect of chemical coupling (through fluid density modification and mineral/precipitation dissolution) on fluid flow and radionuclide transport have been ignored. These types of simplifications may introduce unacceptable errors to long-term assessment of contaminant transport. Preferential flow in particular is considered to be an important contaminant transport mechanism in the Hanford vadose zone.

Improvement in modeling of vadose zone transport requires developing models which can capture the important complexities. This development will take the form of enhancing existing codes to represent additional processes, running them with finer grids and time spacings, and simulating some of the heterogeneities and episodicities. Partial coupling of physical and chemical processes may also be needed. It is expected that some potentially complicating processes can be demonstrated to be insignificant, and that the transport behavior produced in the complex models can be abstracted into more highly parameterized models for sitewide assessment and long term predictions.

The specific technical gaps associated with modeling of contaminant transport in the vadose zone are:

- Information is needed to assess the effects of high ionic strength aqueous solutions under varying redox and pH conditions present in some of the leaking storage tanks on the rate of metal/radionuclide migration. Although it is known that high ionic strength solutions change the partitioning behavior of strongly sorbed nuclides, especially alkalis like ^{137}Cs , it is not known quantitatively for a range of likely conditions, nor is it known how fast fluids are neutralized by reaction with the soil matrix, how much this fluid-rock interaction changes the sorption properties of the matrix, and whether the high densities of fluids cause them to flow downward fast enough that the effective surface area for sorption is greatly reduced. A further concern is with non-isothermal effects near the tanks, and in the seepage of highly radioactive tank fluids.
- Techniques are needed to estimate flow, transport, and reaction/interaction parameters from data collected at different scales of observation and for transferring geo-hydrological information from one site to another with an understanding of the limitations of these techniques. These are long standing issues in hydrological modeling, but the approach used needs to be tailored to the type of system being modeled, and there needs to be enough data to estimate what sacrifices in terms of uncertainty are being made by using data measured at one scale to represent larger and smaller scales.
- Techniques are needed to adequately account for spatial and temporal heterogeneity that impacts contaminant transport. There is a need to model water seepage, and associated mass transport, on the actual scale on which these processes are taking place. This may require spatial resolution of order 0.1 - 1 m, and temporal resolution of order 1 hr - 1 day. How such resolution can be reconciled with site-wide modeling and assessment on time scales of 10 - 100 yr is a major challenge. The episodic nature of seepage, and associated hysteresis and mixing effects must also be accounted for. Episodic and intermittent features can come into play from the nature of precipitation and runoff, from tank leaks, and when considering sluicing to remove tank contents.

The temporal structure of unsaturated zone seepage may be as important as the spatial structure (Science Needs RL-WT044-S).

- Improved multiphase-multicomponent reactive transport models that adequately describe contaminant migration in the Hanford vadose zone are needed. These models should include groups of specialized submodels relating to specific waste chemistry and other features that support site-specific and provide a basis for site-wide assessments. Current vadose zone modeling uses decoupled approaches. There are some process aspects (chemical reaction-induced changes in porosity, permeability, reactive surface area) that can only be captured through fully coupled modeling.
- Approaches for considering and incorporating uncertainty in transport modeling is needed to better communicate what is or is not known. This is also a widely appreciated aspect of hydrological modeling, but there are many possible approaches, and one or more need to be developed, decided upon and gain the acceptance of the concerned community.
- Information is needed to understand which secondary minerals form as colloids in groundwater, the importance of biosorption, the nature of the chemical interactions between contaminants of interest and the surfaces of inorganic and organic colloids, and the effect of colloids on contaminant transport at Hanford (Science Need RL-SS28-S).
- Information is needed to understand how the physical and chemical properties of the specific Hanford formations affect the transport of chemical solutes and colloids (Science Need RL-SS29-S).
- Techniques and information are needed to quantify the migration rate of contaminants through the vadose zone. Model formulations are needed for the chemistry and physics that describe the dispersal and longevity of subsurface contaminant plumes for site conditions, contaminant chemistry and reactivity, and hydraulic properties at Hanford (Science Need RL-SS31-S). The evolution of the present distribution of contaminants, both radioactive and nonradioactive (particularly ^{137}Cs but also Pu, ^{99}Tc , ^{90}Sr , Cr, CCl_4 , and nitrate), beneath the tank farms and past practice disposal sites and to evaluate their potential mobility under all “leave or retrieve” options needs to be understood and quantified (Science Need RL-WT053-S). Techniques are needed to use readily measured chemical analogues (similar group, charge, ionic size) to contaminants of interest to assess the behavior of difficult-to-measure contaminants in the Hanford subsurface (Science Need RL-SS35-S).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T Roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with descriptions contaminant transport in the vadose zone is needed in the FY99 to FY03 timeframe to meet these objectives.

Problem Description: This need falls under the Vadose Zone Technical Element within the S&T Endeavor. The Vadose Zone Technical Element is intended to address and resolve scientific problems related to the leakage of radioactive and hazardous wastes into Hanford soils and sediments. The objective of the Vadose Zone Technical Element is to enhance protection of human health and the

environment by providing 1) improved models, measurements, and data to predict contaminant migration and provide warning of potential surface or groundwater contamination before problems arise; 2) scientific rigor to system assessment and PA models as they are developed, reviewed, and implemented; and 3) scientific support for selection of the most safe, efficient, and effective remedial actions and site closure activities. An implicit goal of this research is to provide scientific and regulatory credibility to DOE's environmental management decision-making process.

The scope of this technical element encompasses the unsaturated zone beneath the Hanford Site. The geographic focus is on areas that (1) underlie liquid waste disposal sites; (2) have the potential for leaks or leaching; and (3) have experienced past leaks and spills. Also included are selected areas away from the focus areas, such as areas representative of background conditions, and areas that have the potential to become contaminated in the future.

Specific topics for this need include (1) scientifically defensible predictive tools and (2) detailed process-level reactive transport models to provide a foundation for site-scale models for site-wide assessments.

Benefit to the Project Baseline of Filling Need: The application of surface barriers and other remediation strategies currently planned for the Hanford Site depends on improved measurements of transport processes in the vadose zone. Confidence in predicting contaminant travel times at treated or covered sites will be enhanced by implementing this activity. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must describe and quantify contaminant transport in the Hanford vadose zone or provide relevant parameters or mathematical formulations such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0012

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: Previously employed approaches for modeling vadose zone transport do not capture essential processes that affect contaminant migration at Hanford. Previous modeling efforts have used decoupled approaches even though radionuclide and contaminant transport may involve fully coupled thermal-hydrological-mechanical-chemical processes. In addition, the effect of chemical coupling (through fluid density modification and mineral/precipitation dissolution) on fluid flow and radionuclide transport have been ignored. These types of simplifications may introduce unacceptable errors to long-term assessment of contaminant transport.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND AND QUANTIFY WATER MOVEMENT IN THE VADOSE ZONE USING UNCONTAMINATED FIELD SITES

Identification No.: RL-SS30

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Understand and Quantify Water Movement in the Vadose Zone using Uncontaminated Field Sites

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The rate of movement of contaminants from buried waste through the vadose zone to groundwater is presently not well documented for Hanford Site conditions. Neither the chemical or physical mechanisms for flow and transport in the vadose zone are well understood. Prior to recent efforts by the River Protection Project (RPP) Tank Farm Vadose Zone Project to characterize the S-SX and B, BX-BY tank farms, few boreholes in the tank farm area have been cored and analyzed for both hydraulic properties

and chemistry (Freeman-Pollard et al., 1994; Myers et al., 1998) and rates of vadose zone migration are still indeterminate for most, if not all of the contaminants of concern. Moreover, little is known about the physical and chemical processes that are most significant over protracted contact times of the waste with the sediments in the vadose zone (Jones et al., 1998) and this has led to predictions of flow and transport that are plagued with large uncertainties. These processes may differ significantly from short term ones studied in the laboratory. Within this context, the effects of extreme waste chemistry, unsaturated water conditions and complex, geologically controlled water flow paths add to the uncertainty of contaminant movement (Conway et al., 1997; Conway et al., 1998). Without such information, little can be said about the long-term stability of the in-ground contaminant inventory; has it been immobilized or is it available for transport? Recent groundwater monitoring reports (see for example, Johnson and Chou, 1998; Hodges, 1998; Narbutovskih, 1998) have also highlighted some of the uncertainties in vadose zone/groundwater interactions.

Rates of transport to groundwater may range from decades to thousands of years, depending on the nature of the waste and the amount and location of the water sources that mobilize waste and carry it to the water table. No direct measurement of net water infiltration (the primary driver for fluid migration in the vadose zone) has been made at any Hanford waste site (Smoot et al. 1989, Ward et al. 1997). In addition, accelerated flow paths (channels etc.) may funnel contaminants more rapidly than current hydrologic models predict (Conaway et al. 1997, 1998) via preferred pathways caused by geologic features, by dissolution of sediments from extreme wastes, or unstable wetting fronts. Fast flow pathways may be tortuous and of limited horizontal extent so that locating them with widely spaced boreholes will be difficult. Temporal variations in vadose zone fluxes are also expected as a results of variations in surface-controlled net water infiltration, spatially distributed preferential flow paths, and temporally/spatially discrete waste-water discharges. These temporal fluxes are important and are assumed to cause observed transient peaks in groundwater contamination levels. Elucidating these phenomena is important to the understanding of the nature and extent of contamination determined during field characterization at contaminated sites and subsequently, forecasting future extent of contamination during and after remediation.

The primary technical gap associated with transport in the vadose zone is an insufficient understanding of uncertainties in source terms, geohydrologic properties, and chemical interactions that combine to make current modeling of contaminant transport in the Hanford vadose zone questionable. The sediments beneath waste sites at Hanford are known to be highly heterogeneous (e.g., interbedded sand, silts and gravels). These heterogeneities, coupled with temporal and spatial variations in net water infiltration (via past liquid discharges, water line leaks, meteoric sources, etc.) and variable chemical interactions complicate description and understanding of contaminant transport, often making an evaluation of transport at contaminated sites ambiguous.

Specific issues that need to be addressed to resolve this technical gap include the following:

- Information on the nature and extent of preferred flow paths in Hanford vadose zone sediments is needed. Specific information needed includes the following. A determination of which geologic and lithologic features are associated with preferred flow paths and under what moisture conditions they function as conduits is needed. Techniques to determine the length scales over which preferred flow paths are present at Hanford. Information is needed to determine which waste chemistries are conducive to formation of preferred flow paths and what hydrochemical reactions are most important in the field and to what extent they control in situ flow velocities and direction. Information to determine to what extent laboratory-derived reaction parameters are descriptive of geochemical phenomena occurring in preferred flow paths and, if differences are observed, what in situ features cause the differences. In addition, information is needed to determine whether fast radionuclide migration pathways through the vadose zone exist and, if so,

their origin. Appropriate model formulations that include the impact of preferential flow pathways and the near-field impacts of thermal and pressure (advective) enhancements in predictive flow and transport models are also needed.

- Techniques are needed to determine the frequency of preferred flow paths in the Hanford vadose zone as well as an understanding of the geologic and lithologic features and moisture content associated with the flow paths. Documentation of the distribution of the flow pathways will provide a basis for more realistic predictions of early arrival of contaminant plumes. Quantification of the flow pathways may help explain why mobile elements such as technetium-99 and nitrate, are being discovered in elevated concentrations in some groundwater wells near tank farms and not in others (Science Need RL-WT035-S).
- Information is needed to determine the extent to which hydrochemical reactions that create preferred pathways influence the in situ flow velocity and direction. These reactions influence the in-situ flow velocity and direction. Parameters are needed that clearly define the interactive role of waste chemistry and hydrologic reactivity when physically hot brine interacts with Hanford sediment and alters the hydrologic flow regime (Science Need RL-WT035-S).
- Information is needed to determine the best field-scale values and statistics for hydraulic and geochemical parameters and the approach to best derive and transfer these parameters. There is a need to develop approaches that best derive and transfer these parameters to other locations and depths in the Hanford vadose zone (Science Need RL-WT035-S).
- Information is needed to determine net water infiltration for a given waste site at Hanford. The variability may include vegetation dynamics (resulting from disturbances, fires, drought) and its impact on the local and regional recharge rates that ultimately control contaminant migration rates. The spatial and temporal variation of the water infiltration rates, can drastically affect the amount of contaminant moving to groundwater from a given waste site. Such information has been lacking in the predictive modeling of risk and dose from Hanford waste areas and the impact of these variation need to be documented. (Science Needs RL-WT035-S and RL-WT044-S).
- Means to quantify the distribution of recharge throughout the Hanford Site as well as through an individual waste site, the variability (uncertainty) possible in the distribution of recharge, and the time delay between recharge through the land surface and that into the water table are needed (Science Need RL-WT044-S).
- The interaction of the factors that effect water recharge variables across a sparsely vegetated landscape over long times (thousands of years) need to be understood and incorporated into estimates of long-term rates of water infiltration (Science Need RL-WT044-S).
- The impact of future land and water use and potential climate changes on water infiltration needs to be understood and incorporated into modeling efforts to predict the transport of contaminants (Science Need RL-WT044-S).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with water movement in the vadose zone is needed in the FY02 to FY03 timeframe to meet these objectives.

Problem Description: This need falls under the Vadose Zone Technical Element within the S&T Endeavor. The Vadose Zone Technical Element is intended to address and resolve scientific problems related to the leakage of radioactive and hazardous wastes into Hanford soils and sediments. The objective of the Vadose Zone Technical Element is to enhance protection of human health and the environment by providing 1) improved models, measurements, and data to predict contaminant migration and provide warning of potential surface or groundwater contamination before problems arise; 2) scientific rigor to system assessment and PA models as they are developed, reviewed, and implemented; and 3) scientific support for selection of the most safe, efficient, and effective remedial actions and site closure activities. An implicit goal of this research is to provide scientific and regulatory credibility to DOE's environmental management decision-making process.

The scope of this technical element encompasses the unsaturated zone beneath the Hanford Site. The geographic focus is on areas that (1) underlie liquid waste disposal sites; (2) have the potential for leaks or leaching; and (3) have experienced past leaks and spills. Also included are selected areas away from the focus areas, such as areas representative of background conditions, and areas that have the potential to become contaminated in the future.

Specific topics for this need include (1) a comprehensive data set with clear boundary conditions and known source functions to validate conceptual and numerical models of water movement through the Hanford vadose zone; (2) procedures for scaling up laboratory-derived parameters (e.g., chemical reaction parameters, hydraulic properties, etc.); and (3) input to site-specific and site-wide assessments that provide realistic assessment of plume migration rates in the vadose zone sediments at Hanford

Benefit to the Project Baseline of Filling Need: The application of surface barriers and other remediation strategies currently planned for the Hanford Site depends on a clear understanding transport processes in the vadose zone. Confidence in predicting contaminant travel times at treated or covered sites will be enhanced by implementing this activity. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must delineate water infiltration rates or relate water movement to Hanford waste site geology and surface features such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0013

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of uncertainties in source terms, geohydrologic properties, and chemical interactions that combine to make current modeling of contaminant transport in the Hanford vadose zone questionable. The sediments beneath waste sites at Hanford are known to be highly heterogeneous (e.g., interbedded sand, silts and gravels). These heterogeneities, coupled with temporal and spatial variations in net water infiltration (via past liquid discharges, water line

leaks, meteoric sources, etc.) and variable chemical interactions complicate description and understanding of contaminant transport, often making an evaluation of transport at contaminated sites ambiguous.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B.

Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

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Conaway, J.G., Luxmoore, R.J., Matuszek, J.M., Patt, R.O., Wierenga, P.J., Shafter, D.S., 1998. Vadose Zone Expert Panel Meeting, Meeting Closeout Report. DOE/RL-98-67. U.S. Department of Energy, Richland, WA, 99352.

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROVIDE ADVANCED CHARACTERIZATION TOOLS AND METHODS TO DELINEATE CONTAMINANT PLUMES IN THE VADOSE ZONE AND RELATE PLUME DISTRIBUTION TO THE DISTRIBUTION OF GEOCHEMICAL AND HYDROGEOLOGICAL PROPERTIES

Identification No.: RL-SS31

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

☒	1. Critical to the success of the ACPC
☐	2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
☐	3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Provide Advanced Characterization Tools and Methods to Delineate Contaminant Plumes in the Vadose Zone and Relate Plume Distribution to the Distribution of Geochemical and Hydrogeological Properties

Need/Opportunity Category: Technology Need.

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

To support both site-specific and site-wide assessments that lead to effective remediation, advanced characterization tools and methods are needed to determine nature and extent of contamination and to support field investigations to elucidate key features and processes that control contaminant migration. At present, we do not know where more than a few percent of the contaminants are located in the vadose zone (GAO 1989, Ward et al. 1997). Spectral gamma logging of tank farm subsurface contamination has not provided information about the risk drivers (^{99}Tc , ^{129}I , etc.) that currently reside in the vadose zone and are leaking into the groundwater (GJPO 1996, 1998; Conaway et al. 1997, 1998). Advanced characterization tools will provide that information, which is key to knowing when groundwater might be impacted by contaminants that are moving to the water table at accelerated rates (Johnson and Chou 1998, Hodges 1998 and Narbutovskih 1998) from Hanford waste sites (tanks, cribs, trenches, etc.). This information is presently lacking in all the waste management areas (100, 200, 300) but is particularly critical to waste disposal decision in the 100 and 200 Areas, where some wastes may be left in place and isolated with engineered barriers. The potential for migration and the monitoring verification of the contaminant mobility will depend on characterization tools that currently are not deployed at the Hanford Site.

The primary technical gap associated with delineating contaminant plumes in the vadose zone is insufficient soil, geophysical, geochemical, and hydrological data or methods to resolve subsurface heterogeneities, characterize geohydrologic properties, and map contaminant distributions at different scales in the vadose zone. This information is important to determine the physical and chemical properties/parameters of the vadose zone as well as the water and contaminant distribution and flux for use in assessing the potential for future migration or remobilization of contaminants. Specific issues that need to be addressed to resolve this technical gap include the following.

- Characterization methods are needed to define the in situ physical and chemical aspects of the vadose zone, and average field-scale properties describing fluid flow and reaction. These methods need to have the sensitivity to characterize subsurface geohydrologic and geochemical properties with sufficient accuracy to permit prediction of contaminant fate and transport. Specific information needed includes the following: Techniques are needed to determine the distribution of subsurface heterogeneities (natural and those created by waste interaction with the porous medium) that may influence the distribution of soil water and contaminants. Additionally, techniques are needed to delineate the three dimensional (3D) distribution of geohydrological properties in the vadose zone. Techniques are also needed to extrapolate the classical measurements of geohydrologic and transport properties made on small, homogeneous soil cores and in small near-surface experiments to the pertinent field scale at which soil parameters exhibit complex natural heterogeneity.
- Characterization methods are needed to delineate the 3D size and shape of contaminant plumes in the vadose zone. Specific information needed includes the following: Information is needed about how contamination is distributed in the vadose zone beneath different types of waste sites with different source chemistries and different release histories. Information is needed to understand the existing physical, chemical, and mineralogical associations of contaminants and co-contaminants and determine the primary processes that have formed these associations. Information is needed to understand the relationships between contaminant distribution, moisture content, and the physical, chemical, microbiologic, and geologic characteristics of the subsurface sediments. In addition, techniques are needed to map groundwater contaminants and other dissolved species that have reached the groundwater back to their sources.
- Information is needed to determine the chemical form and mobility of dense, non-aqueous phase liquids (DNAPLs and related contaminants, such as chlorinated solvents in contact with (1) pore water and (2) secondary minerals. The distribution of DNAPLs in the vadose zone can greatly

affect the cleanup efficiencies and thus affect costs of cleanup (e.g., over 80% of the carbon tetrachloride inventory is assumed to lie above the water table but its distribution within the vadose zone is unknown). Determination of form and distribution of DNAPLs in the vadose zone will help prioritize cleanup strategies and may greatly reduce cleanup time and costs (Science Need RL-SS25-S).

- Information is needed to understand the physics and chemistry principles that underlie more accurate, more sensitive, and higher resolution measurements of contaminant concentrations in the aqueous and solid (surface) phases. Recent theoretical developments on electromagnetic and electrical field analysis in zones containing high metal contents (buried pipes, well casings, etc.) could lead to less expensive methods for minimally intrusive measures of subsurface contaminant plumes (Science Need RL-SS37-S).
- The Hanford site contains large volumes of contaminated vadose zone and aquifer soils. In some areas, these soils are located at depths of 500 ft while access to other soils is restricted by the presence of surface or near surface objects such as buildings or underground tanks. The Hanford geology also is quite varied and ranges from unconsolidated silty sands to gravels and cobbles. Cost effective technologies that allow access to this wide variety of sediments for both characterization and remediation are required (Technology Need RL-SS25).
- Contaminants with low distribution coefficients and long half-lives like ⁹⁹Tc and ¹²⁹I tend to represent the greatest health risks in long-term risk assessments for the 200 Area tank farms. Also, strontium contamination in the 100 Area soils and ground water presents a near term environmental concern due to its close proximity to the Columbia River. However, it is difficult to measure the inventories and distribution of these contaminants because they only emit beta particles that do not penetrate the surrounding soil. Therefore, the only way to currently obtain data in the vadose zone is through the costly collection of soil samples. Improved, more cost-effective methods of accessing contaminated soils, taking soil samples, and/or measuring the concentration of beta emitting contaminants are required (Technology Need RL-SS26).

Other technology needs that relate to this need include RL-WT102 and RL-WT026.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with delineating contaminant plumes in the vadose zone is needed in the FY02 to FY03 timeframe to meet these objectives.

Problem Description: This need falls under the Vadose Zone Technical Element within the S&T Endeavor. The Vadose Zone Technical Element is intended to address and resolve scientific problems related to the leakage of radioactive and hazardous wastes into Hanford soils and sediments. The objective of the Vadose Zone Technical Element is to enhance protection of human health and the environment by providing 1) improved models, measurements, and data to predict contaminant migration and provide warning of potential surface or groundwater contamination before problems arise; 2) scientific rigor to system assessment and PA models as they are developed, reviewed, and implemented; and 3) scientific support for selection of the most safe, efficient, and effective remedial actions and site closure activities. An implicit goal of this research is to provide scientific and regulatory credibility to DOE's environmental management decision-making process.

The scope of this technical element encompasses the unsaturated zone beneath the Hanford Site. The geographic focus is on areas that (1) underlie liquid waste disposal sites; (2) have the potential for leaks or leaching; and (3) have experienced past leaks and spills. Also included are selected areas away from the focus areas, such as areas representative of background conditions, and areas that have the potential to become contaminated in the future.

Specific topics for this need include (1) improved downhole otherwise minimally intrusive methods for determination of physical and chemical properties/parameters of the Hanford vadose zone and (2) improved downhole and minimally intrusive methods for determination of contaminant distribution and flux.

Benefit to the Project Baseline of Filling Need: The application of surface barriers and other remediation strategies currently planned for the Hanford Site depends on improved measurements of transport processes in the vadose zone. Confidence in predicting contaminant travel times at treated or covered sites will be enhanced by implementing this advanced characterization activity. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must delineate contaminant plume distributions and geochemical and hydrogeological property distributions such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0013

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There are insufficient soil, geophysical, geochemical, and hydrological data or methods to resolve subsurface heterogeneities, characterize geohydrologic properties, and map contaminant distributions at different scales in the vadose zone. This information is important to determine the physical and chemical properties/parameters of the vadose zone as well as the water and contaminant distribution and flux for use in assessing the potential for future migration or remobilization of contaminants.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

Conaway, J.G., Luxmoore, R.J., Matuszek, J.M., Patt, R.O., Wierenga, P.J., Shafter, D.S., 1998. Vadose Zone Expert Panel Meeting, Meeting Closeout Report. DOE/RL-98-67. U.S. Department of Energy, Richland, WA, 99352.

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Johnson, V.G., Chou, C.J., 1998. Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas S-SX at the Hanford Site. PNNL-11810. Pacific Northwest National Laboratory, Richland, WA, 99352

Narbutovskih, S.M., 1998. Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas B-BX-BY at the Hanford Site. PNNL-11826. Pacific Northwest National Laboratory, Richland, WA 99352

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

Ward, A. L., G. W. Gee and M. D. White. 1997. A comprehensive analysis of contaminant transport in the vadose zone beneath tank SX-109. PNNL-11463. Pacific Northwest National Laboratory, Richland, Washington.

SUBSURFACE CONTAMINANTS

Groundwater

Groundwater Element Index to Linked Needs

RL-SS32	Understand and Quantify the Relationship Between Contaminant Sources, Vadose Zone Plume Properties and Groundwater Plume Properties with a Focus on the Groundwater-Vadose Zone Interface
RL-SS03	Improved, Real-Time, In-Situ Detection of Carbon Tetrachloride in Groundwater
RL-SS06	Improved, Real-Time, In-Situ Detection of Hexavalent Chromium in Groundwater
RL-SS33	Provide Means to Delineate Regional Groundwater Plumes in Three Dimensions and Define a Science Basis for Addressing Scaling Issues in Hanford Groundwater
RL-SS25	Improved, Cost-Effective Methods for Sub-Surface Access to Support Characterization and Remediation
RL-SS34	Understand, Quantify and Develop Descriptions of Biogeochemical Reactions and Interactions Between Contaminants of Concern and Aquifer Sediments to Describe Biochemical Reactive Transport
RL-SS23-S	Chemical Speciation and Complexation in Site-Specific Groundwaters
RL-SS24-S	Chemical Binding on Site-Specific Mineral Surfaces
RL-SS25-S	Chemical Form and Mobility of Dense, Non-Aqueous Phase Liquids in Hanford Subsurface Transport of Contaminants
RL-SS26-S	Reaction Rates for Key Contaminant Species and Complexes in Site-Specific Groundwaters
RL-SS27-S	Rate of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface
RL-SS28-S	Rates of Colloid Formation and Colloidal Transport of Contaminants in Site-Specific Groundwaters
RL-SS31-S	Mathematical Formulations of Chemical Reaction/Material Transport
RL-SS32-S	Reactivity of Organics in the Hanford Subsurface
RL-SS35-S	Use of Chemical surrogates for Contaminants
RL-SS35	Provide Means to Quantify the Flux of Contaminant Between the Groundwater and the Columbia River

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND AND QUANTIFY THE RELATIONSHIP BETWEEN CONTAMINANT SOURCES, VADOSE ZONE PLUME PROPERTIES AND GROUNDWATER PLUME PROPERTIES AT HYDROLOGIC BOUNDARIES WITH A FOCUS ON THE GROUNDWATER-VADOSE ZONE INTERFACE

Identification No.: RL-SS32

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Understand and Quantify the Relationship Between Contaminant Sources, Vadose Zone Plume Properties and Groundwater Plume Properties at Hydrologic Boundaries with a Focus on the Groundwater-Vadose Zone Interface

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

This specific need addresses the near-source vertical distribution of contaminants in groundwater. The primary technical gap is an inadequate understanding of the processes that control the transport of

contaminants across the vadose zone/groundwater interface and the resulting vertical distribution within the aquifer. Variables involved include: contaminant properties, waste characteristics such as density, chemistry, volume of the waste, influences of artificial water recharge, and the nature of the contaminant release from the vadose zone to the groundwater. This information is important to resolve current inventory estimates associated with groundwater plumes and to estimate the flux of contaminants from the vadose zone to groundwater. Information about vertical distribution of the groundwater plume near the source is also important to help infer how contaminants move through the vadose zone. For example, deeply distributed carbon tetrachloride in the aquifer beneath Plutonium Finishing Plant disposal sites implies drainage of a DNAPL through the vadose zone that “settles” in the aquifer. Contaminant concentrations that are highest in the capillary fringe, or at the very top of the aquifer, would imply unsaturated flow through the vadose zone and a low pore fluid density. Specific needs to address the vadose zone/groundwater interface technical gap include the following.

- Innovative approaches to determine the rate and nature of contaminant delivery from the vadose zone to the groundwater in 3D are needed. These approaches include the reevaluation of historical data to infer vertical distribution of contaminants in groundwater as well as demonstrating effective depth-discrete sampling tools (related to Technology Needs RL-SS03 and RL-SS06).
- Evaluation of temporal issues and relating these issues to seasonal or source term issues is needed to support site-wide assessment. Infiltration rates from the vadose zone to the groundwater control the quantity and timing of contaminant flux.
- Developing an understanding of the relationship between vadose zone capillary fringe and 3D plume geometry in the groundwater near the contaminant sources and controlling processes for contaminant migration through the vadose zone is needed to provide diagnostic information. Recent comments by a peer-review panel for the proposed Hanford site-wide groundwater model pointed out the need for addressing sources of uncertainty, including those introduced by alternate conceptual models. The interface between the vadose and groundwater is a key relationship that needs to be better understood to support analyses that will be performed.
- Techniques that provide representative physical and chemical data during borehole/well installation to delineate contaminant plume distribution and chemistry in the capillary fringe and in the aquifer near the water table are needed. Techniques are also needed to assess the representativeness and quality of sample/data collection methods for the capillary fringe and groundwater.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with the groundwater-vadose zone interface is needed in the FY 2000 to FY 2004 timeframe to meet these objectives.

Problem Description: This need falls under the Groundwater Technical Element within the S&T Endeavor. The Groundwater Technical Element is intended to address and resolve scientific issues related to understanding the role of groundwater in the overall migration of contaminants from the Hanford Site. The objective of the Groundwater Technical Element is to enhance protection of the

Columbia River and its environs by 1) determining the existing distributions of contaminants with particular emphasis on 3D distribution especially at the interfaces with the vadose zone and the river and 2) enhancing the understanding of geological, chemical, geochemical, and hydrologic controls for future movement of contaminants. Detection of contaminants in groundwater monitoring wells underlying tanks, cribs, landfills, and other sources has often been the first indication of releases and migration. Understanding the flux and dynamics of vadose-capillary fringe-groundwater contaminant transfer and plume migration in three dimensions is critical to reconstructing vadose zone transport. On a larger scale, transport processes in groundwater control migration to extraction wells or surface water bodies (e.g., the Columbia River), define future risk scenarios, and affect the potential for optimized cleanup. An implicit goal of this research is to provide sufficient knowledge and data and identify existing and new S&T for input to DOE's decision-making process for Hanford cleanup.

This technical element provides the information, analytic capabilities, and understanding required for improving the technical basis for assessments of Hanford Site impacts to groundwater resources and the Columbia River. Groundwater represents an important portion of the potential exposure path and is the link between the source/vadose system and receptors at a well or the river. The technical scope of the groundwater element complements that of the vadose zone element by extending the characterization work into the saturated sediments under the Hanford Site. The saturated zone includes the capillary fringe, the unconfined aquifer, aquitards, and uppermost confined aquifers. The technical scope of the groundwater element also complements that of the river element by providing input to contaminant flux to the river and other interactions between the groundwater and Columbia River. Major topics include (1) the distribution of contamination within the saturated sediments; (2) the hydrology, geology, geochemistry, and microbiology of the saturated zone; (3) groundwater flow and transport of contamination; and (4) numerical models that depict the movement of water and contaminants.

Benefit to the Project Baseline of Filling Need: Information gained by filling this need will provide appropriate delineation of contaminant distribution and relation of plumes to sources. Thus, there will be less uncertainty in the technical basis used for decisions. The activity that this need supports will be used to support development of the System Assessment Capability (SAC) as part of the GW/VZ Integration Project. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must delineate contamination and describe processes at the groundwater-vadose zone interface such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project. The information must provide a better understanding of current conditions, and the ability to assess potential future conditions for near- and long-term scenarios.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of the relationship between vadose zone contamination properties (e.g., the plume distribution, contaminant source properties, waste properties such as density, chemistry, and volume of the waste, and influences of artificial water recharge) and the nature of the contaminant release from the vadose zone to the groundwater. This information is important to resolve current inventory estimates associated with groundwater plumes and to estimate the flux of contaminants from the vadose zone to the groundwater. Information about the groundwater plume below the discharge area is also important to help infer transport of contaminants through the vadose zone.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TECHNIQUES TO DELINEATE GROUNDWATER PLUMES IN THREE DIMENSIONS AND DEFINE A SCIENTIFIC BASIS FOR ADDRESSING SCALING ISSUES IN HANFORD GROUNDWATER

Identification No.: RL-SS33

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- ___ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ___ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Techniques to Delineate Groundwater Plumes in Three Dimensions and Define a Scientific Basis for Addressing Scaling Issues in Hanford Groundwater

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

This need focuses on the extension of our current knowledge of groundwater characteristics to support site-wide assessments. The structure and development of the regional groundwater plumes is critical to estimating inventory of contaminants in groundwater for site-wide assessments. This plume structure also provides information about controlling hydrogeology and is critical to calibrating and documenting

the quality/performance of numerical models. In addition, hydrogeological characterization at multiple scales is needed to understand and predict the flows and transport at Hanford. As recommended by the peer review panel for the Hanford site-wide groundwater model in a recent review, the first step in developing this knowledge is evaluating the sources of uncertainty in the model. This will provide direction to areas where the characterization can have the greatest impact in reducing uncertainty.

The proposed need emphasizes the need for understanding the vertical penetration of contaminant plumes, both near sources and in regional plumes as contaminants travel toward the Columbia River. Developing a technically based understanding of this 3D behavior is important at several scales and is needed to reduce the uncertainty and improve the SAC at Hanford. Until recently, most site modeling and characterization of the groundwater has been performed in two dimensions with emphasis on the upper portion of the water table. Contaminants penetrating below this interval as a result of regional infiltration, geological features, or waste characteristics have not been fully addressed.

Near a waste disposal source, the vertical concentration profile and contaminant penetration are diagnostic of the release (volume, contaminant concentrations, and waste properties). Regionally, infiltration and boundary conditions result in plume trajectories that dip downward near the source, and then upward near the Columbia River. In both of these cases, the penetration and 3D plume geometry is strongly dependent on geological controls. Understanding this behavior will improve interpretation of data and will improve the robustness of models. This is especially important as predictions are extended to future conditions that differ significantly from the present day – i.e., what happens to the plumes when future groundwater levels decline and the water table is in the Ringold instead of the Hanford Formation?

This need targets technologies and approaches to fill this data gap in creative and cost effective ways and in a manner that is compatible with Hanford requirements and stakeholder values.

Specific issues that need to be addressed to resolve this technical gap include the following:

- Information is needed to understand how to incorporate the 3D properties of contaminant plumes and regional-scale data into predictions of plume fate and transport. To provide input to fate transport models, techniques are needed to obtain representative data for the 3D distribution and chemistry of groundwater contaminant plumes and depth discrete and regional-scale information on aquifer hydrogeological properties. Means to assess the representativeness and quality of these sample/data collection methods are also needed.
- As part of the analysis of fate and transport for contaminants, information is needed to understand the relationship between the migration pattern of high mobility contaminants (e.g., ^3H , ^{99}Tc , and nitrate) and the migration pattern of moderate to low mobility (e.g., ^{129}I , ^{90}Sr , ^{127}Cs , and ^{60}Co) contaminants.
- An improved understanding of groundwater conditions such as high water levels to the east of the Columbia River is needed to describe and predict the subsurface distribution of contaminants. High water levels in east of the river will deflect contaminant plumes and alter the outcrop location – moving it upstream and toward the Hanford bank. Understanding this large scale, 3D concept will improve the technical basis for river impact assessment.
- Information is needed to determine which scales of physical/hydrological heterogeneity definition are needed to effectively predict contaminant fate and transport for both site-specific and site-wide assessments. Additionally, information is needed to understand how to relate hydraulic measurements acquired with different support scales or different volumes of investigation.

- An approach for defining and accounting for uncertainty of 3D contaminant distribution is needed for conceptual and numerical modeling of regional and site-specific plume structure.
- Information is needed on behavior of DNAPL and LNAPL wastes at Hanford. These wastes, such as dense CCl_4 and co-contaminants dissolved in the CCl_4 , follow different migration paths than the dissolved contaminants in the groundwater.

Improved access to the subsurface that reduces cost and increases data density and improved methods for sampling groundwater are needed. Specifically, drilling costs with existing technology reduce the number of wells that can be drilled for characterization. New methods are needed for discrete-depth sampling of groundwater from both existing wells and during installation of new wells (Technology Need RL-SS25).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with delineating groundwater plumes is needed in the FY 2000 to FY 2004 timeframe to meet these objectives.

Problem Description: This need falls under the Groundwater Technical Element within the S&T Endeavor. The Groundwater Technical Element is intended to address and resolve scientific issues related to understanding the role of groundwater in the overall migration of contaminants from the Hanford Site. The objective of the Groundwater Technical Element is to enhance protection of the Columbia River and its environs by 1) determining the existing distributions of contaminants with particular emphasis on 3D distribution especially at the interfaces with the vadose zone and the river and 2) enhancing the understanding of geological, chemical, geochemical, and hydrologic controls for future movement of contaminants. Detection of contaminants in groundwater monitoring wells underlying tanks, cribs, landfills, and other sources has often been the first indication of releases and migration. Understanding the flux and dynamics of vadose-capillary fringe-groundwater contaminant transfer and plume migration in three dimensions is critical to reconstructing vadose zone transport. On a larger scale, transport processes in groundwater control migration to extraction wells or surface water bodies (e.g., the Columbia River), define future risk scenarios, and affect the potential for optimized cleanup. An implicit goal of this research is to provide sufficient knowledge and data and identify existing and new S&T for input to DOE's decision-making process for Hanford cleanup.

This technical element provides the information, analytic capabilities, and understanding required for improving the technical basis for assessments of Hanford Site impacts to groundwater resources and the Columbia River. Groundwater represents an important portion of the potential exposure path and is the link between the source/vadose system and receptors at a well or the river. The technical scope of the groundwater element complements that of the vadose zone element by extending the characterization work into the saturated sediments under the Hanford Site. The saturated zone includes the capillary fringe, the unconfined aquifer, aquitards, and uppermost confined aquifers. The technical scope of the groundwater element also complements that of the river element by providing input to contaminant flux to the river and other interactions between the groundwater and Columbia River. Major topics include (1) the distribution of contamination within the saturated sediments; (2) the hydrology, geology, geochemistry, and microbiology of the saturated zone; (3) groundwater flow and transport of contamination; and (4) numerical models that depict the movement of water and contaminants.

Benefit to the Project Baseline of Filling Need: The information generated to address this need will provide high quality estimates of contaminant position and behavior. Precise understanding the location of contaminant plumes is the most important basis for efficient and optimized remedial actions. The activity that this need supports will be used to support development of the SAC as part of the GW/VZ Integration Project. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must delineate contamination distribution such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project. The information must provide a better understanding of current conditions, and the ability to assess potential future conditions for near- and long-term scenarios.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: The structure of the regional plume for highly and moderately mobile contaminants is not fully defined and, thus, there is a limited scientific basis for collecting and representing geologic and hydrologic data over a variety of scales. The structure and development of the regional groundwater plumes is critical to estimating inventory of contaminants in groundwater for site-wide assessments and providing critical data to support site-wide groundwater modeling and its integration into the SAC being developed as part of the GW/VZ Integration Project. This plume structure also provides information about controlling hydrogeology and is critical to calibrating and documenting the quality/performance of numerical models. In addition, hydrogeological characterization at multiple scales is needed to understand and predict flow and contaminant transport at Hanford.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND, QUANTIFY AND DEVELOP DESCRIPTIONS OF BIOGEOCHEMICAL REACTIONS AND INTERACTIONS BETWEEN CONTAMINANTS OF CONCERN AND AQUIFER SEDIMENTS TO DESCRIBE BIOCHEMICAL REACTIVE TRANSPORT

Identification No.: RL-SS34

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>
<u> </u>
<u> </u> | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
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Need Title: Understand, Quantify and Develop Descriptions of Biogeochemical Reactions and Interactions Between Contaminants of Concern and Aquifer Sediments to Describe Biochemical Reactive Transport

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

This need focuses on the reactions and interactions between contaminants and aquifer sediments. The primary technical gap is an insufficient understanding of these processes at Hanford in terms of

quantifying and parameterizing the processes for use in reactive transport modeling and to determine appropriate conceptual models. Biogeochemical reactions may result in either enhanced contaminant mobility, degradation (natural attenuation), or fixation in the unconfined aquifer. An understanding of these fundamental processes is needed to predict the long-term behavior of contaminants as they enter the unconfined aquifer and during transport along the groundwater flow path to the river. The need for reactive transport modeling has been pointed out by several recent peer reviews at the Hanford Site, one for the RPP vadose zone contamination issue and more recently for the Hanford site-wide groundwater model. Specific needs to address this technical gap include the following.

- Mobility of transuranic (TRU) radionuclides (especially neptunium-237) in the groundwater, including the potential for complexation with DNAPL and the potential for colloid formation and transport.
- Information is needed to determine and quantify reactions such as biodegradation and interactions with aquifer sediments that impact the fate of dissolved DNAPL such as CCl_4 in the groundwater.
- Techniques are needed to measure chemical, physical, and biological reactions and interactions in the aquifer and parameterize these measurements for use in models. Additionally, appropriate model formulations of these reactions and interactions are needed such that they can be incorporated into fate and transport models.
- Information is needed to understand the relationship between geochemical reactions and hydrogeological properties that affect transport in the aquifer.
- Descriptive kinetic and thermodynamic information for reactions and interactions in the aquifer based on key biogeochemical and hydrochemical reactions that control the fate and transport of contaminants in the groundwater are needed. Specific information needed includes the following. Determination of the speciation and complexation of contaminants of interest in the aquifer (Science Need RL-SS23-S). Information is needed to understand the reactions that will affect the binding of contaminants in solution on secondary mineral surfaces, and on primary phases (Science Need RL-SS24-S). The reaction rates and the key reaction steps that control the speed with which a contaminant changes chemical form (e.g., speciation, complexation) and/or interacts with the surfaces of secondary minerals need to be quantified (Science Need RL-SS26-S). An understanding of the effect of coupled abiotic and biogeochemical reactions for which independent rates of reaction are known on contaminant form (e.g. speciation/complexation) is needed (Science Need RL-SS27-S). As is relevant to the fate and transport of carbon tetrachloride, information is needed to understand and quantify the rates of degradation reactions of naturally occurring organic matter and synthetic organic compounds that supply energy to subsurface biological consortia that participate in dechlorination of halogenated solvents (Science Need RL-SS32-S).
- Information is needed determine the chemical form and mobility of DNAPLs such as chlorinated solvents in the aquifer (Science Need RL-SS25-S).
- Information is needed to understand which secondary minerals form as colloids in groundwater, the importance of biosorption, the nature of the chemical interactions between contaminants of interest and the surfaces of inorganic and organic colloids, and the affect of colloids on contaminant transport at Hanford (Science Need RL-SS28-S).

- Model formulations are needed for the chemistry and physics that describe the dispersal and longevity of subsurface contaminant plumes for site conditions, contaminant chemistry and reactivity, and hydraulic properties at Hanford (Science Need RL-SS31-S).
- Techniques are needed to use readily-measured chemical analogues (similar group, charge, ionic size) to contaminants of interest to assess the behavior of difficult-to-measure contaminants in the Hanford subsurface (Science Need RL-SS35-S).
- Evaluation of naturally occurring microbial communities in the groundwater and their impact on radionuclide and metal mobility is needed to understand current and predict future migration of contaminants.

The use of site-specific media (appropriate Hanford Site groundwater and sediments) are essential for all laboratory testing involved in acquiring the above information. Also, care must be taken to acquire “undisturbed” sediment samples to avoid altering the chemical reactivity of the natural materials.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with reactions and interactions in the aquifer is needed in the FY 2000 to FY 2004 timeframe to meet these objectives.

Problem Description: This need falls under the Groundwater Technical Element within the S&T Endeavor. The Groundwater Technical Element is intended to address and resolve scientific issues related to understanding the role of groundwater in the overall migration of contaminants from the Hanford Site. The objective of the Groundwater Technical Element is to enhance protection of the Columbia River and its environs by 1) determining the existing distributions of contaminants with particular emphasis on 3D distribution especially at the interfaces with the vadose zone and the river and 2) enhancing the understanding of geological, chemical, geochemical, and hydrologic controls for future movement of contaminants. Understanding the flux and dynamics of vadose-capillary fringe-groundwater contaminant transfer and plume migration in three dimensions is critical to reconstructing vadose zone transport. On a larger scale, transport processes in groundwater control migration to extraction wells or surface water bodies (e.g., the Columbia River), define future risk scenarios, and affect the potential for optimized cleanup. An implicit goal of this research is to provide sufficient knowledge and data and identify existing and new S&T for input to DOE’s decision-making process for Hanford cleanup.

This technical element provides the information, analytic capabilities, and understanding required for improving the technical basis for assessments of Hanford Site impacts to groundwater resources and the Columbia River. Groundwater represents an important portion of the potential exposure path and is the link between the source/vadose system and receptors at a well or the river. The technical scope of the groundwater element complements that of the vadose zone element by extending the characterization work into the saturated sediments under the Hanford Site. The saturated zone includes the capillary fringe, the unconfined aquifer, aquitards, and uppermost confined aquifers. The technical scope of the groundwater element also compliments that of the river element by providing input to contaminant flux to the river and other interactions between the groundwater and Columbia River. Major topics include (1) the distribution of contamination within the saturated sediments; (2) the hydrology, geology,

geochemistry, and microbiology of the saturated zone; (3) groundwater flow and transport of contamination; and (4) numerical models that depict the movement of water and contaminants.

Benefit to the Project Baseline of Filling Need: Information gained by filling this need will provide an appropriate description of important reactions and interactions related to contaminant transport. Thus, there will be less uncertainty in the technical basis used for decisions. The activity that this need supports will be used to support development of site-specific assessments as well as the SAC as part of the GW/VZ Integration Project. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must describe and quantify reactions and interactions between contaminants of concern and aquifer sediments such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project. The information must provide a better understanding of current conditions, and the ability to assess potential future conditions for near- and long-term scenarios.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of these processes at Hanford in terms of quantifying and parameterizing the processes for use in reactive transport modeling and to determine appropriate conceptual models. Biogeochemical reactions may result in either enhanced contaminant mobility, degradation (natural attenuation), or fixation in the unconfined aquifer. An understanding of these fundamental processes is needed to predict the long-term behavior of contaminants as they enter the unconfined aquifer and during transport along the groundwater flow path to the river for both site-specific assessments as well as to provide support for parameters used in the SAC.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TECHNOLOGIES TO QUANTIFY THE FLUX OF CONTAMINANT FROM HANFORD GROUNDWATER TO THE COLUMBIA RIVER

Identification No.: RL-SS35

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Technologies to Quantify the Flux of Contaminant from Hanford Groundwater to the Columbia River

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

This need focuses on the delivery of contaminants from the groundwater to the river. Re-examination of boundary conditions and boundary fluxes was a key recommendation of the recent peer review of the Hanford Site-wide groundwater model. The necessary technologies and approaches focus on the distal portion of the Hanford groundwater plume. Information collected will provide robust information on

contaminant releases and provide a sensitive system for monitoring the arrival of contaminants. This technical approach minimizes the artifacts associated with changing river stage and will improve the groundwater release estimates used in the Hanford site-wide groundwater model and its integration into the SAC and enhance stakeholder credibility.

Specific issues that need to be addressed to resolve this technical gap include techniques to measure overall contaminant fluxes from the groundwater to the river. The techniques should be designed so that they will not be significantly impacted by the transient effects and measurement artifacts associated with the river stage. They are needed to provide a better estimate of contaminant flux. These techniques should provide representative monitoring data and depth discrete information on contaminant distribution and flux in the aquifer near the river. Additionally, techniques are needed to assess the representativeness and quality of these depth discrete groundwater monitoring methods. These needs focus on determining how contaminants discharge to the river – along the shoreline, in the bed of the river, and how far out into the river – and determining how these discharges are affected by daily and seasonal variations of river stage.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with quantifying contaminant flux is needed in the FY05 timeframe to meet these objectives.

Problem Description: This need falls under the Groundwater Technical Element within the S&T Endeavor. The Groundwater Technical Element is intended to address and resolve scientific issues related to understanding the role of groundwater in the overall migration of contaminants from the Hanford Site. The objective of the Groundwater Technical Element is to enhance protection of the Columbia River and its environs by 1) determining the existing distributions of contaminants with particular emphasis on 3D distribution especially at the interfaces with the vadose zone and the river and 2) enhancing the understanding of geological, chemical, geochemical, and hydrologic controls for future movement of contaminants. Detection of contaminants in groundwater monitoring wells underlying tanks, cribs, landfills, and other sources has often been the first indication of releases and migration. Understanding the flux and dynamics of vadose-capillary fringe-groundwater contaminant transfer and plume migration in three dimensions is critical to reconstructing vadose zone transport. On a larger scale, transport processes in groundwater control migration to extraction wells or surface water bodies (e.g., the Columbia River), define future risk scenarios, and affect the potential for optimized cleanup. An implicit goal of this research is to provide sufficient knowledge and data and identify existing and new S&T for input to DOE's decision-making process for Hanford cleanup.

This technical element provides the information, analytic capabilities, and understanding required for improving the technical basis for assessments of Hanford Site impacts to groundwater resources and the Columbia River. Groundwater represents an important portion of the potential exposure path and is the link between the source/vadose system and receptors at a well or the river. The technical scope of the groundwater element complements that of the vadose zone element by extending the characterization work into the saturated sediments under the Hanford Site. The saturated zone includes the capillary fringe, the unconfined aquifer, aquitards, and uppermost confined aquifers. The technical scope of the groundwater element also complements that of the river element by providing input to contaminant flux to the river and other interactions between the groundwater and Columbia River. Major topics include (1) the distribution of contamination within the saturated sediments; (2) the hydrology, geology, geochemistry, and microbiology of the saturated zone; (3) groundwater flow and transport of contamination; and (4) numerical models that depict the movement of water and contaminants.

Benefit to the Project Baseline of Filling Need: The information generated to address this need will provide high quality estimates of contaminant flux and provide a sentinel (early warning) system for future contaminant arrival. The robustness and defensibility of the data will provide the basis for efficient and optimized remedial actions. The activity that this need supports will be used to support development of site-specific assessments as well as the SAC as part of the GW/VZ Integration Project. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must quantify the contaminants flux to the river such that the information can be applied toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project. The information must provide an accurate understanding of current conditions, and the ability to assess potential future conditions for near- and long-term scenarios.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0014

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of the horizontal location, vertical structure, and location of the groundwater contamination as it approaches and enters the Columbia River. This information is necessary to document the near-river transport path of contaminant plumes to the receptor and will be used by the site-wide groundwater model and its integration into the SAC.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

SUBSURFACE CONTAMINANTS

River

River Element Index to Linked Needs.

RL-SS36	Provide means to integrate regional-scale phenomena into assessments of contaminant transport and impacts within the Columbia River.
RL-SS37	Provide methodology to relate information derived from sitewide-scale groundwater flow modeling to the various scales associated with assessing impacts in the river environment
RL-SS38	Understand, quantify and develop descriptions of transport and transformation of groundwater-derived contaminants of concern in the river
RL-SS39	Understand and Provide Means to Quantify the Impacts of River Contamination on Receptors

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROVIDE MEANS TO INTEGRATE REGIONAL-SCALE PHENOMENA INTO ASSESSMENTS OF CONTAMINANT TRANSPORT AND IMPACTS WITHIN THE COLUMBIA RIVER

Identification No.: RL-SS36

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- ___ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ___ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Provide Means to Integrate Regional-Scale Phenomena into Assessments of Contaminant Transport and Impacts Within the Columbia River

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The primary technical gap for this specific need is the lack of a quantitative understanding of the regional (watershed) factors that influence the distribution, transport, and chemical form of contaminants from Hanford operations on the Columbia River. Key factors include river flow parameters; sediment movement and sedimentation; water hardness, pH, and water temperature; the distribution of gravel,

cobble, and silt/clay sediments within the Hanford Reach and downstream; and the redox status and acid-volatile sulfide contents of softbottom sediments in these areas. Although all of these factors are known or suspected to be important in determining contaminant movement and bioavailability, there is little capability to predict either (a) the responses of these factors to regional conditions or (b) the combined effects of these factors on contaminants.

The science gap to be filled by this need is a hierarchical series of models that define regional interrelationships with regard to their effects on contaminant mobility, distribution, and bioavailability. Specifically, these models include:

- A conceptual model that relates inputs to the Hanford Reach from upriver to the physical/chemical state of contaminants entering via groundwater, and thereafter affect transport. This model must also incorporate understanding of the biological relationships between contaminants and the nutrients for which they are analogues, as well as movement of background contaminants (e.g., heavy metals from Lake Roosevelt, fallout products in River sediments) into the Reach and downstream.
- A GIS visualization of the distribution of substrate conditions within the Reach to McNary Dam, and below.
- A semiquantitative model that will provide order-of-magnitude estimates of the effects on transport and bioavailability due to uncertainty in the key factors.
- A quantitative model that is capable of converting regional-scale phenomena (e.g., hydropower operations, El Niño weather patterns, cleanup of the Spokane River) into quantitative estimates of physical/chemical conditions pertinent to quantifying contaminant transport within the river system.

The technology gaps include development of tools to measure the primary contributors to contaminant mobility, distribution, and bioavailability in a cost-effective manner. These include:

- Hyporheic probes capable of operation in shallow and deep waters under a variety of current speeds and rapidly-changing water depths
- Refined sediment, pore water, and water sampling tools capable of discrete sampling over short vertical distances
- Underwater visualization tools hybridized with accurate GPS to map substrates.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with regional-scale phenomena is needed in the FY04 timeframe to meet these objectives.

Problem Description: This need falls under the River Technical Element within the S&T Endeavor. The River Technical Element is intended to support and provide information necessary for an assessment of the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-

dependent life, and users of river resources. The objectives of the river technical element are to provide relevant and meaningful information to support remedial decisions and subsequent risk and system assessments, to guide ongoing and subsequent environmental surveillance programs, and to focus future iterations of the cumulative river assessment. Meeting the objectives will enhance protection of human health and the environment by providing scientifically defensible knowledge and data and identifying existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The scope of this technology need relates to information needs associated with background contaminant inputs, nutrient conditions, benthic conditions, and physical/chemical properties of the water and sediments that will form the basis for predicting the fate and transport of contamination entering this river environment from Hanford groundwater. These include spatial/temporal flow patterns, hardness, pH, temperature, DOC, nutrient load, and sediment load and characteristics entering the Hanford Reach, physical transport of water-phase and particulate-phase contaminants in the Reach and downstream (as affected by hydropower operations downstream), and changes in bioavailability of the contaminants themselves. Interaction with the suspended load of the river, and with biological systems, is key to anticipating the fate of contaminants. Erosion and deposition patterns for the river are major topics for understanding where potential contaminant sinks are located, and where sensitive species and humans are at greatest potential threat of exposure. Understanding how the channel morphology and its distribution of sediments evolve (with time) is key to anticipating future conditions.

Credible conceptual and numerical models for processes occurring in this zone are crucial to (1) identifying impacts to the river's ecosystem; and (2) quantifying risks to aquatic and human receptors. This zone encompasses near-river groundwater and infiltrated river water (bank storage), and the hyporheos (sediment pore water and biota immediately beneath the free-flowing stream). The Columbia River technical element scope includes the capability to provide information necessary to assess accurately and credibly the risk posed by Hanford Site contaminants to aquatic, terrestrial, and human receptors in the river environment.

Benefit to the Project Baseline of Filling Need: Predictive capability is needed for decisions regarding impacts within the Hanford Reach and downstream. As demonstrated in the CRCIA study (DOE 1998), background inputs of contaminants as well as nutrients severely affects assessments of level of impact – heavy metal inputs from upriver of Hanford may account for as much as 90% of the present impacts within the Reach. Furthermore, the concentrations of nutrients for which certain contaminants are analogues (e.g., Ca and Sr) can greatly affect biological uptake and transport, in some cases altering bioconcentration factors by as much as 3 to 4 orders of magnitude (Cushing et al. 1988). Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must provide an accurate understanding of current conditions and the ability to assess potential future conditions, near- and long-term, as they impact contaminant concentrations, form, transport, and bioavailability. In addition, the evaluation must allow for the differentiation between contaminant contributions from Hanford and other sources (natural and/or anthropogenic). The information obtained must be applicable toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There currently is inadequate understanding of the relative importance of regional-scale phenomena relative to contaminant transport and bioavailability within the Hanford Reach and downstream, nor is there the quantitative capability to integrate these into useful models. This information is needed to develop a numeric model of the river system that includes the critical processes and components necessary to conduct the assessments required to meet the objectives of the project.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

Cushing, C. E.; Rickard, W. H., and Watson, D. G. 1988. Radionuclide Accumulation by Aquatic Biota Exposed to Contaminated Water in Artificial Ecosystems Before and After Its Passage Through the Ground. NUREG/CR-5047, U.S. Nuclear Regulatory Commission Washington, DC, 19 pp.

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROVIDE METHODOLOGY TO RELATE INFORMATION DERIVED FROM SITEWIDE-SCALE GROUNDWATER FLOW MODELING TO THE VARIOUS SCALES ASSOCIATED WITH ASSESSING IMPACTS IN THE RIVER ENVIRONMENT

Identification No.: RL-SS37

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- _____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- _____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Provide Methodology to Relate Information Derived from Sitewide-Scale Groundwater Flow Modeling to the Various Scales Associated with Assessing Impacts in the River Environment

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The technical gap associated with this need involves the means by which contaminant transport information derived from groundwater flow models (see RL-SS35) can be used when conducting impact assessments for various elements of the river system. The problem involves relating the spatial and

temporal scales associated with a Pasco Basin groundwater transport model, to the scales associated with assessing impacts to sensitive habitat and individual receptors. New methods are needed to establish credible estimates for contaminant characteristics at exposure sites in the river, when using the output from groundwater transport models. Organisms potentially exposed to groundwater-derived contaminants may occupy one or more microhabitats that will significantly affect their exposure to groundwater. Thus, benthic invertebrates such as larval insects may be exposed to pure groundwater in some cases, and nearly pure river water in others (e.g., Hope and Peterson 1996). Because river water over much of the Reach does not contain contaminants in concentrations sufficient to put organisms or humans at risk (in contrast to groundwater), the differences in assessment of impact can be dramatic (DOE 1996).

Specific aspects of research to address this technical gap include the following:

- Developing the modeling capabilities to quantify the changes in groundwater characteristics that take place in the zone of interaction between the aquifer and the river.
- Developing the modeling capabilities to characterize the flow path of water within the zone of interaction, which is strongly influenced by river stage fluctuations.

Developing the algorithms for estimating contaminant concentrations in the river environment (using the output from groundwater flow models – see RL-SS38) that consider the potential physical and chemical changes that may occur in the zone of interaction. This model will provide the capability to convert a broad-scale groundwater flux into a spatially-distributed set of concentrations in three dimensions as the flux enters the river environment. This model will reflect the benthic substrate diversity, river flow, and river physio-chemical characteristics (see RL-SS36) necessary to provide concentration estimates that reflect bioavailability as well as habitat specificity.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with contaminant flux is needed in the FY04 timeframe to meet these objectives.

Problem Description: This need falls under the River Technical Element within the S&T Endeavor. The River Technical Element is intended to support and provide information necessary for an assessment of the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources. The objectives of the river technical element are to provide relevant and meaningful information to support remedial decisions and subsequent risk and system assessments, to guide ongoing and subsequent environmental surveillance programs, and to focus future iterations of the cumulative river assessment. Meeting the objectives will enhance protection of human health and the environment by providing scientifically defensible knowledge and data and identifying existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The scope of this technology need encompasses the groundwater-river interface as it relates to the fate and transport of groundwater contamination entering the river environment. These include factors that modify the physical/chemical form and concentration of groundwater-borne contaminants within the zone of influence of the Columbia River up to the point that they enter the river proper.

Key topics in this need include mixing (dilution) with river water, effects of geochemical conditions of the sediment and river water on contaminant physical and chemical state, the influence of preferential pathways (e.g., cobble vs. silt-clay sediments), and the effects of spatial heterogeneity in hyporheic sediment composition on contaminant concentrations entering the river. Credible conceptual and numerical models for processes occurring in this zone are needed to quantify accurately (1) impacts to the river's ecosystem; and (2) risks to human receptors.

Benefit to the Project Baseline of Filling Need: Filling this need will reduce the uncertainty in impact and risk assessments associated with river-related receptors. The uncertainties introduced in converting groundwater flux information into biological exposures are large, and may cover several orders of magnitude (DOE 1996). In the absence of this technology, a variety of conservative estimations have been used at Hanford that may greatly inflate (DOE 1998) or underestimate (DOE 1993) risks. The uncertainty in decisions about cleanup and impact may therefore be large. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must provide an accurate understanding of current conditions over time and the ability to assess potential future conditions, near- and long-term. In addition, the evaluation must allow for the differentiation between contaminant contributions from Hanford and other sources (natural and/or anthropogenic). The information obtained must be applicable toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There are insufficient means to translate groundwater contaminant flux estimates into information at the scale of biological exposures that are necessary to estimate impacts from groundwater contaminants entering the river.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in "Columbia River Comprehensive Impact

Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

Hope, S.J., and R.E. Peterson. 1996. Chromium in River Substrate Water and Adjacent Groundwater: 100-D/DR Area, Hanford Site, Washington. BHI-00778, Bechtel Hanford, Inc., Richland, Washington.

United States Department of Energy. 1993. Columbia River Impact Evaluation Plan. DOE/RL-92-28, U.S. Department of Energy, Richland, Washington.

United States Department of Energy. 1998. Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND, QUANTIFY, AND DEVELOP DESCRIPTIONS OF TRANSPORT AND TRANSFORMATION OF GROUNDWATER-DERIVED CONTAMINANTS OF CONCERN IN THE RIVER

Identification No.: RL-SS38

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Understand, Quantify, and Develop Descriptions of Transport and Transformation of Groundwater-Derived Contaminants of Concern in the River

Need/Opportunity Category: Technology Need.

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The primary technical gap associated with reactions and interactions between contaminants and sediments in the river and bank-storage region involves insufficient understanding of these processes at Hanford in terms of quantifying and parameterizing the processes for use in the development and application fate and transport. An understanding of these fundamental processes is needed to predict the fate and transport of

contaminants into and through the river. Specific issues that need to be addressed to resolve this technical gap include the following.

- The chemical, physical, and biological reactions and transformations that occur within the bank storage region (i.e., zone of interaction between the near river aquifer and vadose zone sediments that are affected by river stage fluctuations) can greatly affect the form, concentration, and spatial/temporal distribution of contaminants moving within the surface water system. Bank storage clearly delays downstream transport of water-borne contaminants, and may prolong aquatic biological exposures in the nearshore environments. In addition, bank storage may enhance exposures of terrestrial species to contaminants not otherwise found in the groundwater at these regions (Brandt et al. 1993).
- Physics-based transport models (hydraulic, sediment, contaminant) are needed to represent the movement of contaminants into and through the river environment.
- Numerical models are needed that incorporate the chemical, physical, and biological reactions and interactions in the river for contaminants in aqueous phase (dissolved species), colloid phase, and sediment phase into the physics-based transport models based on hydraulics and sediment transport.
- Models are needed to predict changes in the bioavailability, bioaccumulation, and biodegradation of contaminants for the development of representative biological transport models, based on the numerical models identified above.

Techniques/equipment/instrumentation are desired to measure chemical, physical, and biological parameters in the bank-storage region and the river to parameterize, validate, and verify these models.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with reactions and interactions is needed in the FY04 timeframe to meet these objectives.

Problem Description: This need falls under the River Technical Element within the S&T Endeavor. The River Technical Element is intended to support and provide information necessary for an assessment of the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources. The objectives of the river technical element are to provide relevant and meaningful information to support remedial decisions and subsequent risk and system assessments, to guide ongoing and subsequent environmental surveillance programs, and to focus future iterations of the cumulative river assessment. Meeting the objectives will enhance protection of human health and the environment by providing scientifically defensible knowledge and data and identifying existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The scope of this technology need relates to information needs associated with the fate and transport of groundwater-based contamination once it enters the river environment. These include understanding the contaminant characteristics (type, nature, concentration, decay/attenuation qualities) as they relate to the physical and chemical conditions of the river as it enters the Hanford Reach as developed in RL-SS36. Understanding the interactions of the contaminants with the dissolved organic matter, suspended load,

and biological systems of the river, as well as the role of bank storage in altering the timing, chemical nature, and concentration of contaminants as they move through the river system are key to accurately predicting the fate of contaminants.

Key topics in this zone include the following:

- Mixing processes within the river
- Geochemical conditions of the water and sediments that affect bioavailability and transport
- Life history descriptions and parameters for key species relative to quantification of exposure
- Food web structure and biological transport parameters for key species and habitats
- Bank storage and physical/chemical transformations within the river bank
- Numerical river flow and sedimentation models that account for the daily-fluctuating hydrograph of the managed river system.

Credible conceptual and numerical models for processes occurring in this zone are crucial to (1) identifying impacts to the river's ecosystem; and (2) quantifying risks to aquatic and human receptors.

Benefit to the Project Baseline of Filling Need: Filling this need will improve the state-of-the-art of river transport modeling to couple biological transport, physical transport, and physical/chemical state of the contaminants. Bank storage will be included as a prolonged source of contaminant exposure, and both its modulating capacity and ability to diffuse contaminated surface water into the surrounding terrestrial biota will be addressed. These changes will improve decisions regarding impacts downstream from groundwater plumes. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must provide an accurate understanding of current conditions over time and the ability to assess potential future conditions, near- and long-term. In addition, the evaluation must allow for the differentiation between contaminant contributions from Hanford and other sources (natural and/or anthropogenic). The information obtained must be applicable toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0014

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of reactions and interactions of contaminants and sediments at Hanford in terms of quantifying and parameterizing the processes for use in reactive transport modeling and for determining appropriate conceptual models. An understanding of these fundamental processes is needed to predict the fate and transport of contaminants in the river.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERSTAND AND PROVIDE MEANS TO QUANTIFY THE IMPACTS OF RIVER CONTAMINATION ON RECEPTORS

Identification No.: RL-SS39

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5])

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Understand and Provide Means to Quantify the Impacts of River Contamination on Receptors

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

The primary technical gap associated with the impacts of river contamination on receptors is that there is an insufficient understanding of the human, ecological, cultural and socio-economic impacts of contaminants that reach the river and the relationship between contaminants entering the river and behavioral impacts on culture and socio-economics. Currently, standard impact assessment practice involves comparing estimated exposures of individual organisms to a lowest observed effects level toxicological benchmarks, such as behavioral change or tissue-level alterations. Regulated exposure

levels are sometimes also based on no observed effects levels, which have a number of inadequacies aside from their level of biological resolution (Chapman et al. 1996). In either case, however, the interest of regulation and impact assessment is not at the individual or sub-individual level, but at the level of the population and its properties, such as abundance, health, productivity, etc. There is a need to develop consistent metrics upon which to determine impacts (human, ecological, cultural, socio-economic) that are useful in the decision-making process and reflective of appropriate level of organization of the focus receptor groups. The development of consistent metrics includes the quantitative capability for translating an individual-level dose-response into the impact metrics that are important to regulators and stakeholders, including the general public (see Levin et al. 1989, Newman and Jagoe 1996).

Specific technical gaps associated with the development of impact metrics include the following.

- Appropriate toxicological benchmarks need to be developed for contaminants likely to enter the river, involving species important from ecological and human perspectives. This need includes information to determine the impacts from diverse contaminant mixtures, e.g., accounting for potential synergistic/antagonistic effects.
- Understanding the ecological interactions and processes within the affected system such that a reasonable prediction of higher-order effects (e.g., at the population level) can be made based on toxicological benchmarks. For example, translating a genetic-level toxicological benchmark into a population survival/productivity change effect.
- Information is needed to translate ecological impacts into cultural and socio-economic impacts.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with impacts of contamination is needed in the FY04 timeframe to meet these objectives.

Problem Description: This need falls under the River Technical Element within the S&T Endeavor. The River Technical Element is intended to support and provide information necessary for an assessment of the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources. The objectives of the river technical element are to provide relevant and meaningful information to support remedial decisions and subsequent risk and system assessments, to guide ongoing and subsequent environmental surveillance programs, and to focus future iterations of the cumulative river assessment. Meeting the objectives will enhance protection of human health and the environment by providing scientifically defensible knowledge and data and identifying existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The scope of this technology need includes effects of contaminant exposures on the biota, cultures, and socioeconomics associated with the Columbia River.

Key issues in this technical area include developing credible conceptual and numerical models for (1) identifying toxicological impacts to the river's ecosystem; and (2) quantifying meaningful effects relative to ecological attributes and human receptors. Key information needs include identifying (1) toxicological benchmarks for regional species of concern for contaminants of concern; (2) definitions of desired metrics to assess impacts; (3) effects of complex contaminant mixtures; and (4) translational models for converting toxicity into impact metrics for human and ecological endpoints.

Benefit to the Project Baseline of Filling Need: Information gained by filling this need will reduce the uncertainty in the technical basis for quantifying the impacts of river contamination on receptors. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must provide an accurate understanding of current conditions over time and the ability to assess potential future conditions, near- and long-term. In addition, the evaluation must allow for the differentiation between contaminant contributions from Hanford and other sources (natural and/or anthropogenic). The information obtained must be applicable toward the conceptual models, fate and transport numerical models, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is an insufficient understanding of the human, ecological, cultural and socio-economic impacts of contaminants that reach the river and the relationship between contaminants entering the river and behavioral impacts on culture and socio-economics. This information is necessary to accurately and credibly assess of risk posed by Hanford Site contaminants to aquatic, terrestrial, and human receptors in the river environment.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: This need addresses broad sitewide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

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United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

SUBSURFACE CONTAMINANTS

Inventory

Inventory Element Index to Linked Needs.

RL-SS40	Provide a method to develop mass balance (i.e., holistic) inventory estimates
RL- WT090	Chemical and Physical Behavior of Sludge Wastes
RL- WT091	Chemical and Physical Behavior of Saltcake Wastes
RL-WT070	Uncertainty Estimation of Hanford Best Basis Toxic Waste Inventory, Concentration, Phase and Waste Type
RL-WT01	Technetium-99 Analysis in Hanford Tank Waste and Contaminated Tank Farm Areas
RL-SS42	Provide method for more accurate estimates of waste constituent release rates and modes from waste
RL-WT068	Radionuclide Source Term from Tank Residuals

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROVIDE A METHOD TO DEVELOP MASS BALANCE (I.E., HOLISTIC) INVENTORY ESTIMATES

Identification No.: RL-SS40

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating:

- X 1. Critical to the success of the ACPC
- _____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- _____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Provide a Method to Develop Mass Balance (i.e., Holistic) Inventory Estimates

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Currently, there is not a full inventory data set for all of the contaminants of interest for all of the waste sites of interest at Hanford. These data are needed as input to the SAC which is a suite of tools and data that will be used to assess the cumulative effects of Hanford operations and remediation on the Columbia River and river supported life. Based on scoping studies currently underway within the SAC, key radionuclide and chemical contaminants of most concern for assessing cumulative impacts will be

identified. From previous experience, we know there will be gaps in inventory data for many of these contaminants, and that these gaps will contribute significantly to uncertainty in the final assessment.

There is a desire within the stakeholder and Tribal Nation community that all contaminants be included in the inventory model. The purpose of such an exhaustive model would be to ensure that all wastes and all associated impacts would be quantified. It has been suggested that if a specific radionuclide or chemical were not identified as a key contaminant, then it could be lumped with other non-key contaminants and carried throughout the transport and impact estimation process. The non-key contaminants would be represented as a lumped inventory, a lumped transport plume, and a lumped human, ecological, cultural, and socioeconomic consequence. However, once a waste-site specific assessment has been undertaken, the multiple waste types and variety of waste site locations of a Hanford Site assessment make the lumping of inventory, release, transport and impact assessment difficult if not intractable. Consequently, the initial inventory module for the SAC will focus on key radionuclides and chemicals.

The desire of the stakeholder community and Tribal Nations to track all contaminants would be an extension of the initial inventory module and the initial system assessment. Lumping the inventory, its migration and fate, and its impact assessment may not be tractable because of the distributed nature of the multiple-source problem and the desire to represent the uncertainty of disposal on a waste site-by-waste site basis. Clearly, a single simulation could not be conducted and the results scaled for individual waste sites, (e.g., scaled up for some and down for others), to maintain a mass balance of the inventory.

Currently, individual projects use conservative bounding inventory estimates, but use of this approach is not realistic for a site-wide assessment. Use of a conservative or bounding inventory estimate by an individual project can be useful when releases are shown to result in de minimus or low consequences. Projects, (e.g., RPP), are beginning to address a spectrum of inventory issues, (e.g., inventory to be separated into high- and low-level fractions, low-level waste disposal, and the disposal of secondary waste streams from separations and vitrification plants). With these multiple drivers, they too can rely less on a conservative or bounding inventory and need a realistic inventory estimate characterized by a mean and standard deviation. Hence, the primary technical gap is the need to develop a mass balance (i.e., holistic) inventory estimate that results in realistic inventories and estimates of uncertainty. This estimate needs to have a scientifically credible basis such as use of process chemistry and historical records to estimate release quantity, waste chemistry, release location, and time of release from Hanford processes to soil sites.

Specific needs include the following:

- Definition of post-closure Hanford waste site groupings that can be traced to the processes from which wastes were generated and discharged (DOE 1997). These groupings become the basis for developing realistic estimates of waste inventory in the environment over space and time.
- Enhancement of the "Hanford Defined Waste" (HDW) model (Agnew et al. 1997) using process chemistry is needed to estimate the range of probable waste composition, quantities, release locations, and timing of releases. This process chemistry information includes improved partitioning models and tank inventory models (Science Need RL-WT090 and RL-WT091). The process chemistry and tank inventory models are needed by the RPP to support development of pretreatment processes for waste immobilization and disposal. However, radionuclide and chemical partitioning within tank waste will also aid in the determination of soil column inventories, both for planned releases to cribs and trenches and unplanned historical releases (i.e., past leaks). An improved understanding of ⁹⁹Tc and ⁷⁹Se, for example, will improve estimates of releases to soils for these contaminants, both of which are important in performance assessments.

- Expansion and enhancement of the HDW model are needed to represent non-tank waste and to identify clearly crib and trench discharges of tank wastes. All past practice liquid discharge sites ready for closure including ponds, cribs, ditches, reverse wells, and specific retention trenches are Environmental Restoration sites (DOE 1999). The chemical separations conducted in the canyon buildings yielded waste streams that were discharged directly to ditches and cooling ponds, chemical sewers, and cribs. Some resulted in significant plumes, (e.g., tritium), that are routinely used for model history matching. Because they were not tank wastes, they are not included in the current HDW model. Additional waste streams and inventories not accounted for in the existing HDW model that need to be added are the Plutonium Finishing Plant (PFP) building, plutonium uranium extraction (PUREX) tunnels, solid waste burial grounds, graphite cores from production reactors, ancillary piping, and residues in the canyon buildings. In addition to these new wastes, the original tank wastes discharged to cribs and trenches and reported in the HDW model need to be identified with specific cribs and trenches instead of being reported as global crib discharges. As in the original HDW model, the revised model shall provide a probabilistic representation of the inventory.
- Determination of ^{79}Se and ^{126}Sn half-lives for which conflicting values have been reported is needed for inventory and system/performance assessment purposes. ^{79}Se is important for long-term protection of the environment. ^{126}Sn is important in the protection of inadvertent intruders. For purposes of the system assessment inventory measurement of the half-lives within $\pm 50\%$ is sufficient. Other projects require $\pm 10\%$.
- Estimation of released waste inventory and uncertainty for ^3H , ^{60}Co , ^{99}Tc , ^{90}Sr , ^{137}Cs , ^{129}I , U , ^{237}Np , Pu , Am , Na , Al , Cr , CCl_4 , OH^- , NO_3^- , complexants, pH, density, ionic strength, heat load, water weight %, water vapor pressure, and redox state as needed. This first listing of inventory needs is a result of an initial review of radionuclides and chemicals found to be significant in the assessment of both plateau and near-river waste sites. Coordination with RPP which has a need to estimate uncertainty of Hanford Best Basis toxic waste inventory, concentration, phase and waste type (Technology Need RL-WT070) will be beneficial to multiple projects.
- Specific models for ^{99}Tc , ^{129}I , and tritium need to be established to transition from conservative to mass-balance models of inventory. The ^{99}Tc model is needed to reconcile ^{99}Tc inventory. Consistent with new mass balances being completed by the RPP in FY99. This model must also be able to reconcile inventory problems for ^{99}Tc uncovered from past work such as the Composite Analysis (Kincaid et al 1998), e.g., shipment of ^{99}Tc offsite with uranium and underestimates of ^{99}Tc discharges to cribs receiving wastes from the uranium recovery campaign. Likewise, a model for ^{129}I is needed to reconcile inventory completeness issues discovered from past work on the Composite Analysis. The iodine model is complex because will include aspects of atmospheric emissions, stack scrubbers, scrubber regeneration, scrubber failure, and scrubber disposal. A model for tritium is needed to help in benchmarking the overall inventory model and the overall vadose zone and groundwater models that are essential components of the SAC. Future efforts may uncover additional contaminants for which selected models may be needed and will be added to this need in the future as required.
- An accurate, robust production laboratory method for the measurement of ^{99}Tc concentration in Hanford waste tank matrices and in soils from the vadose zone surrounding the tanks is needed (Technology Need RL-WT01). The method must provide a high level of confidence in the ^{99}Tc concentrations because the data is important in risk-based assessments. The development of this method is needed so that data can be obtained to benchmark the process chemistry, release, vadose zone, and groundwater models.

- Characterization methods to determine organic species in tank waste are needed. There are two aspects to this need: 1) The speciation of the organic compounds determines the complexing characteristics of the organic compound. The complexing nature can affect the behavior of other waste components and can affect the mobility of specific components in the waste and in the vadose zone. 2) Measurement of the amount of certain *Resource Conservation and Recovery Act* (RCRA) and *Toxic Substances Control Act of 1976* (TSCA) organic compounds in the waste is important to risk-based assessments.
- Direct methods for inorganic and organic analyses of high level waste would reduce turn-around time, waste production, and worker exposure which would in turn reduce costs. Lower costs for characterization would make it possible to characterize more of the waste tanks and the contaminated zones around and beneath the tanks. The additional data could also be used to improve the benchmarking of the models.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with inventories is needed in the FY03 timeframe to meet the objective of the Integration Project to provide the System Assessment Capabilities with updated inventories that capture uncertainties. Such an analysis will not only satisfy the DOE requirement for active and near-term planned disposal and remediation action decisions, but will also inform DOE-Office of River Protection (ORP) on the cumulative impacts of decisions bearing on tank waste recovery and tank residuals.

Problem Description: This need falls under the Inventory Technical Element within the S&T Endeavor. Inventory is defined as the total quantity of radiological and chemical constituents used and created at the Hanford Site, and their distribution in facilities, waste disposal sites, the vadose zone, groundwater, and Columbia River ecosystem. The Inventory Technical Element is intended to address the need for estimates of radionuclide and chemical contaminants that have been or are expected to be released to Hanford's soil column. Such an inventory would represent the total amount of selected radionuclide and chemical constituents at the Hanford Site and their distribution among facilities, waste disposal sites, vadose zone, groundwater, and Columbia River. The objective of the Inventory Technical Element is to enhance protection of human health and environment by providing estimates of the location, amounts, concentrations, chemical form, and mobilization/release mechanisms of key inventory components, which provides the necessary input to site-wide subsurface system assessments. An implicit goal of this research is to provide scientifically defensible knowledge and data and identify existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The goals of the inventory technical element are largely twofold. First, a consistent approach and set of assumptions for providing information on waste site inventories across the Hanford Site needs to be established to ensure that a site-wide inventory data set is available for system-wide and project-specific impact assessments. Second, key chemical and radiological contaminants and soil sites need to be identified, and estimates of the amount of these key contaminants in different waste forms and storage/disposal areas (e.g., tanks, solid waste burial grounds, other) need to be validated.

A good understanding of inventory is key to a system assessment, because the potential groundwater and river contamination is proportional to the amount of radionuclides and chemicals that are disposed on Hanford Site and capable of migrating off the Site. Technical information needed to determine inventory

include 1) locations, amounts, and concentrations; 2) characteristics of the radionuclide or chemical compound; 3) mobilization and release mechanisms and rates; and 4) the change in inventory because of natural processes (e.g., decay), remediation activities, and Hanford Site operations. In addition to inventory estimates, mechanisms must be identified that result in release of the inventory from facilities into the vadose zone, unconfined aquifer, or the Columbia River. Because the long-term configuration of the waste inventory depends on future remediation and land-use decisions, a baseline estimate of end-state inventory distributions must be defined.

Benefit to the Project Baseline of Filling Need: Completion of a first inventory model based on available data, process chemistry knowledge, and uncertainty principles is essential to any site-wide or system assessment. Currently, there is no single and consistent inventory for the discharges and disposals of radionuclides and chemicals to the surface and subsurface in the 100 B/C, 100 K, 100 N, 100 D, 100 H, 100 F, 300, 200 West and 200 East Areas. This inventory should also provide the basis for investigating existing contamination in the Columbia River by recording the existing knowledge of discharges to the river during the reactor operation period. Successful completion of these activities is required to meet the objectives of the Integration Project and the related elements of the Paths to Closure.

Functional Performance Requirements: The techniques applied or information that is obtained must estimate contaminant inventory such that the information can be applied toward the conceptual models, fate and transport numerical models, site-specific assessments, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0015

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: Currently, there is not a full inventory data set for all of the waste sites and all operational areas at the Hanford Site. This data set is needed as input to the SAC, which is a suite of tools, and data that allow the cumulative effects of Hanford operations and remediation on the Columbia River and associated river supported activities. Previous experience indicates that a lack of a method to provide a realistic estimate of inventory adds substantial (i.e., an order of magnitude) uncertainty in the modeling results (DOE 1999).

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. A site-wide Composite Analysis of all post-closure sources is required every 5 years under DOE Order 5820.2a (and draft DOE Order 435.1). Other site-wide assessments are needed by Environmental Restoration (ER) and RPP to fully understand the nature of competing alternatives (e.g., ER characterization and cleanup versus RPP tank waste recovery and stabilization).

Environmental Safety & Health: This need addresses broad site-wide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues. The CRCIA Part 2 (DOE 1998) guidance requires the assessment of human health, ecological health, and cultural and socioeconomic impacts. All of these societal health metrics are impacted by the broad support of stakeholders and Tribal Nations, (e.g., common health exposure and dose scenarios are being adapted to include exposures typical of Native Americans). As these broad metrics are applied, a longer list of radionuclides and chemicals may be revealed as essential to the assessment.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment.” [Stakeholder and Tribal Nation concerns about the completeness and consistency of the assembly of inventory data and estimates are expressed in the CRCIA Part 2 document (DOE 1998).]

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

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TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROVIDE METHOD FOR MORE ACCURATE ESTIMATES OF WASTE CONSTITUENT RELEASE RATES AND MODES FROM WASTE

Identification No.: RL-SS42

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Provide Method for More Accurate Estimates of Waste Constituent Release Rates and Modes from Waste

Need/Opportunity Category: Technology Need.

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need has both applied S&T components that are interrelated in addressing the specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

To conduct site wide assessments of cumulative impact to the Columbia River and river supported life, the rates of release from waste source terms are needed. Limited data are available on actual release rates. Hence, the primary technical gap is the need for models to describe release rates from all waste that will reside at the Hanford Site in the post-closure period. Thus, models and supporting data are needed for radionuclide and chemical releases from solid waste burial grounds, past tank leaks, future tank losses,

tank residuals, proposed immobilized low-activity waste (i.e., glass), past-practice liquid discharge sites (i.e., crib, ponds, ditches, reverse wells, french drains, and specific retention trenches), canyon buildings (i.e., PUREX, B Plant, T Plant, U Plant, and S Plant), PUREX tunnels, the PFP building, and the graphite cores of production reactors. These modeling results provide temporal and spatial information for system assessments.

Specific issues include the following:

- It is anticipated that some residual waste will reside in the tanks after retrieval, consistent with closure criteria established with the regulators. The solubility/leachability of key constituents in these residuals and the behavior of the released contaminants at the waste-sediment interface is important for setting closure requirements and for estimating future quantity and composition of releases from the tanks and the subsequent impact of the releases. Technetium has been identified as one of the first contaminants to evaluate. It is often a performance assessment driver due to its solubility and mobility in its pertechnetate form. However, recent investigations indicate that much of the Tc may be in the insoluble non-pertechnetate form. It is important to determine the behavior of this contaminant under leaching conditions of tank waste residual and at the waste-sediment interface as it enters the vadose zone. Indeed, the actual release rates of technetium, selenium, and uranium (i.e., the major predicted human health dose contributors) from the tank residuals are essentially unknown. A fundamental understanding and capability to simulate releases from salt cake, sludge, and hard heel in Hanford tanks is needed (Technology Need RL-WT068). This effort supports future studies of tank waste patterned after the Retrieval Performance Evaluation (DOE 1999[RPE]).
- Appropriate release rates from a soil-waste matrix near unplanned tank releases are also needed. The soils have been modified due to contact with high heat and high pH tank wastes, effectively producing a new “waste form.” The rate of release from these areas to underlying soils needs to be determined through activities within Technology Need RL-SS28. The results from those studies will serve as a basis for developing the release model in this need statement. In addition to the release and mobility of past tank leaks that have formed a new waste form in the subsurface, it is important to develop the knowledge required to estimate the release and migration of waste that will follow past tank leaks. Future tank losses and tank residuals from the same tanks will have the opportunity to travel the same path within the vadose zone as the past tank leak. Thus, the influence of the initial leak on the original soil/sediment profile is important to understand as the basis of future releases and their migration and fate.

In addition to residual tank wastes and the vadose zone environment containing past tank leaks, there is a need to develop, document, and obtain technical peer acceptance of a release models for virtually all wastes forms that will remain at the Hanford Site after closure. Release models for graphite cores were developed and applied in the Surplus Production Reactor Environmental Impact Statement (EIS) (DOE 1989, DOE 1992). The RPP is developing release models for low-activity waste glass. Soil-debris models based on solubility and adsorption/desorption physics have been developed and employed for solid waste burial grounds, but may require peer review to document their acceptance. Diffusion-based release models and data are being developed for application to high-integrity concrete containers, but will require peer review before application in analyses supporting large-scale disposals in Hanford Site burial grounds. Conceptual models and supporting data are needed for several key wastes at the Hanford Site including (a) the canyon buildings and their contents, (b) the PUREX tunnels, (c) the PFP facility, (d) ancillary piping throughout the chemical separations areas, (e) stack scrubbers for iodine-129, and (f) the past-practice liquid discharge sites. Some future wastes are still poorly defined but will also require inclusion in a system assessment. These include secondary waste streams and waste disposals generated by the future chemical separation of tank waste into high- and low-level fractions, and the vitrification of

wastes. Examples are radionuclides such as technetium-99 separated from both the high- and low-level fractions and returned to DOE for disposal, and failed melters from the vitrification plants.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE/RL-98-48, 2000) indicates the information that is required over the next 6 years to meet the objectives of the Integration Project. Information associated with contaminant release into the vadose zone is needed in the FY03 timeframe to support the System Assessment Capability.

Because of the variety of contaminant release models that need be developed, documented and peer accepted prior to issuance of a regulatory decision-assisting System Assessment, it may be necessary to schedule this activity over a longer time frame. Thus, scheduling peer review and acceptance of release models very near the time they will be needed to support the assessment (i.e., an environmental impact statement, a composite analysis), rather than requiring peer review and acceptance before the proposed models can be used in prototype simulations.

Problem Description: This need falls under the Inventory Technical Element within the S&T Endeavor. Inventory is defined as the total quantity of radiological and chemical constituents used and created at the Hanford Site, and their distribution in and release from facilities, waste disposal sites, the vadose zone, groundwater, and Columbia River ecosystem. The Inventory Technical Element is intended to address the need for estimates of radionuclide and chemical contaminants that have been or are expected to be released to the Hanford Site soil column. Such an inventory would represent the total amount of selected radionuclide and chemical constituents at the Hanford Site and their distribution among and release from facilities, waste disposal sites, vadose zone, groundwater, and Columbia River. The objective of the Inventory Technical Element is to enhance protection of human health and environment by providing estimates of the location, amounts, concentrations, chemical form, and mobilization/release mechanisms of key inventory components, which provides the necessary input to site-wide subsurface system assessments. An implicit goal of this research is to provide scientifically defensible knowledge and data and identify existing and new S&T that will serve as input to DOE's decision-making process for Hanford cleanup.

The goals of the inventory technical element are largely twofold. First, a consistent approach and set of assumptions for providing information on waste site inventories across the Hanford Site needs to be established to ensure that a site-wide inventory data set is available for system-wide and project-specific impact assessments. Second, key chemical and radiological contaminants and soil sites need to be identified, and estimates of the amount and release characteristics of these key contaminants in different waste forms and storage/disposal areas (e.g., tanks, solid waste burial grounds, other) need to be validated.

A good understanding of inventory and release is key to a system assessment, because the potential groundwater and river contamination is proportional to the amount of radionuclides and chemicals that are disposed on Hanford Site and capable of migrating off the Site. Technical information needed to determine inventory include 1) locations, amounts, and concentrations; 2) characteristics of the radionuclide or chemical compound; 3) mobilization and release mechanisms and rates; and 4) the change in inventory because of natural processes (e.g., decay), remediation activities, and Hanford Site operations. In addition to inventory estimates, mechanisms must be identified that result in release of the inventory from facilities into the vadose zone, unconfined aquifer, or the Columbia River. Because the

long-term configuration of the waste inventory depends on future remediation and land-use decisions, a baseline estimate of end-state inventory distributions must be defined.

Benefit to the Project Baseline of Filling Need: Completion of release models for all wastes based on available data and peer accepted methods is essential to any site-wide or system assessment. Currently, there is no single and consistent suite of containment failure and contaminant release models for the disposals and remediations planned at the Hanford Site. This must include wastes in a post-closure setting in the 100 B/C, 100 K, 100 N, 100 D, 100 H, 100 F, 300, 200 West and 200 East Areas. Because some of the site-wide analyses are required by DOE Order, they will be completed even if the development of data supported and peer accepted release models is not. System assessments conducted without the supporting scientific work are completed and submitted at risk of being rejected. Rejection could impact DOE/HQ issuance of approval for continued disposals, (e.g., LLW disposal in solid waste burial grounds in 200 West, LLW disposal in solid waste burial grounds in 200 East, and *Comprehensive, Environmental Response, Compensation, and Liability Act* (CERCLA) cleanup waste disposal in the Environmental Restoration Disposal Facility).

Functional Performance Requirements: The techniques applied or information that is obtained must estimate containment failure and contaminant release such that the information can be applied toward the conceptual models, fate and transport numerical models, site-specific, and system assessment capabilities that are being developed as part of the Integration Project.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: Current waste constituent release models are not sufficient to estimate the mechanisms and rates of release for all Hanford waste types (e.g., solid wastes, residual tank waste, canyon and PFP buildings, PUREX tunnels, past-practice liquid discharge sites). These estimates are needed for quantifying potential source terms for contaminants.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. Supplemental guidance to DOE Order 5820.2a, and draft DOE Order 435.1, require a Composite Analysis of all post-closure LLW to estimate long-term all-pathways human health impacts. Thus, inventory and release models for all post-closure wastes are needed. A Composite Analysis was completed in 1998 (Kincaid et al. 1998) and must be updated on a 5-year cycle. The Composite Analysis is a companion analysis to performance assessments for active and planned LLW disposals, and remedial actions. Thus, continued disposal authorization at the Hanford Site requires that this the composite analysis be supported and periodically completed. Similarly, continued DOE/HQ support for records of decision for remedial actions requires periodic completion of a composite analysis. The Composite Analysis offers a real opportunity to first quantify and then investigate the issue of uncertainty, and the related issue of the value of additional data investments.

Environmental Safety & Health: This need addresses broad site-wide technical issues and, as such, crosscuts multiple applications that each may have specific environmental safety and health issues.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

A scientifically supported and peer accepted compilation of containment failure and contaminant release models would be of great value to the Hanford Site and would establish a key element of several future analyses including EISs, PAs, feasibility studies, and composite analyses.

Cultural/Stakeholder Concerns: This technology need supports the resolution of cultural and stakeholder concerns as expressed by the CRCIA Team in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment.” [Stakeholder and Tribal Nation concerns about the completeness and consistency of the assembly of containment failure and contaminant release data and estimates are expressed in the CRCIA Part 2 document (DOE 1998)] The regulatory, stakeholder and Tribal Nations also expressed a strong interest in formulations of the system assessment that would quantify the uncertainty in future impacts

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

United States Department of Energy. 1998. *Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment*. DOE/RL-96-16. United States Department of Energy, Richland, Washington.

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C.T. Kincaid, M.P. Bergeron, C.R. Cole, M.D. Freshley, N.L. Hassig, V.G. Johnson, D.I. Kaplan, R.J. Serne, G.P. Streile, D.L. Strenge, P.D. Thorne, L.W. Vail, G.A. Whyatt, and S.K. Wurstner. 1998. *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*. PNNL-11800. Pacific Northwest National Laboratory, Richland, Washington.

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United States Department of Energy. 1989. Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington; Draft Environmental Impact Statement. DOE/EIS-0119D. United States Department of Energy, Washington, D.C.

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SUBSURFACE CONTAMINANTS

Risk

Risk Element Index to Linked Needs.

RL-SS43	Improvements to Ecological Risk Assessments and Analysis of Population-level Impacts
RL-SS44	Improvements to Human Health Risk Assessments
RL-SS45	Establishing Technical Basis for Socio-Economic Risk Assessments
RL-SS46	Modeling Risk Knowledge

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVEMENTS TO ECOLOGICAL RISK ASSESSMENTS AND ANALYSIS OF POPULATION-LEVEL IMPACTS

Identification No.: RL-SS43

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>
<u> </u>
<u> </u> | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--|--|

Need Title: Improvements to Ecological Risk Assessments and Analysis of Population-level Impacts

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of the water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need summarizes a number of S&T components that together address a specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Techniques, technologies, and information that reduce uncertainty in current risk assessments and more-directly address applicable ecological risk guidelines and regulations are needed to address ecological risks posed by contaminants at Hanford. Current techniques and information are insufficient to predict accurately individual exposures to contaminants, especially where food chains and nutrient analogues are

involved, and the effects from this exposure. Thus, conservative assumptions are required that increase uncertainty in the assessment results.

Besides requirements to understand exposures and effects at the individual level, guidelines and regulations are increasingly requiring estimates of risk to populations and ecological functions (Durda and Preziosi 1999). For example, regulations under the Endangered Species Act require assessing individual risks for endangered species, as well as estimating risks for the survival of that species. However, there is insufficient knowledge to characterize population exposures to contaminants and the effects such exposure might have on population processes. Specific needs to address these technical gap include the following:

- Exposure-related information needs:
- Exposure scenarios for specific species groups that are important to food webs at Hanford (for example, data on the relative exposure to surface waters and pore waters of benthic invertebrates in the Reach is not known, nor is the relative uptake from vadose vs. groundwater by deep-rooted riparian plants).
- Toxicokinetic/toxicodynamic models to predict the body burdens of contaminants under spacio-temporally varying exposure conditions in multiple media.
- Methods to predict relative bioavailability of contaminants in multiple media for a diverse set of organisms.
- Methods to measure temporally-varying exposures of aquatic organisms that use areas larger than the area affected by contaminants.
- Techniques are needed to reduce the uncertainty associated with extrapolation of toxicological parameters across taxa.
- Response-related information needs
- Toxicokinetic/toxicodynamic models to predict effects of multiple Hanford contaminants on key species
- Statistical methods and data to more-accurately extrapolate responses measured in one species to responses in other species
- Methods and data to estimate effects of exposures on populations and ecosystem processes, including direct effect approaches, population dynamics models, and ecosystem process models.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE 2000) indicates that the information is required to be implemented as part of the System Assessment Capability, Revision 2. In addition, information associated with key contaminants (e.g., strontium-90 and hexavalent chromium) in the aquatic environment are required for decisions associated with the remediation activities in the 100 Areas by FY 2004 timeframe.

Problem Description: This need falls under the Risk Technical Element within the S&T Endeavor. The Risk Technical Element will provide an assessment of the potential risks to the environment, human health, economic and socio-cultural quality of life from Hanford-derived contaminants. Ecological risk assessments include four phases in the evaluation: problem formulation, exposure characterization, ecological effect characterization, and risk characterization (EPA 1998). This need addresses all four phases of ecological risk assessment and the approaches for fulfilling the need will improve the accuracy, precision and utility of ecological risk assessments at the Hanford Site and throughout the DOE complex.

Benefit to the Project Baseline of Filling Need: Ecological risk assessments are to be required for remediation decisions in the upcoming changes in Washington State's Model Toxics Control Act. These changes include impacts to populations.

Functional Performance Requirements: The application of the knowledge gained through the performance of the specific needs must address the Hanford contaminants and species of interest. The information must result in a better understanding of the uncertainty in current assessments and address upcoming changes in guidelines and regulations.

Work Breakdown Structure (WBS) No : 1.4.03.4.4

TIP No.: TIP-0016

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There currently is insufficient information to address population-level impacts and specific toxicological data to support assessment of many Hanford species. In the absence of the information addressed in this need there is high uncertainty in current ecological risk assessments.

Regulatory: This need specifically addresses EPA guidelines and upcoming changes to Washington State's Model Toxics Control Act on population-level risk assessments. The information obtained by addressing the need will provide an improved technical basis for making decisions.

Environmental Safety & Health: This need specifically addresses environmental safety and health issues across the Hanford Site.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This need supports cultural and stakeholders concerns to address ecological impacts that were expressed in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998). Ecological risk information that is specific for the species that are of most concern are specifically addresses in this need.

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

Durda, J.L., and D.V. Preziosi, 1999, Where's the Population in Your Risk Assessment?, *SETAC News*, November 1999. Society for Environmental Toxicology and Chemistry.

DOE, 1998, *Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment*, DOE/RL-96-16, Revision 1, U.S. Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

EPA, 1998, *Guidelines for Ecological Risk Assessment*, EPA/630/R-95/002F, U.S. Environmental Protection Agency, Washington, D.C.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVEMENTS TO HUMAN HEALTH RISK ASSESSMENTS

Identification No.: RL-SS44

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable unit.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>
<u> </u>
<u> </u> | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
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Need Title: Improvements to Human Health Risk Assessments

Need/Opportunity Category: Technology Need

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of the water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need summarizes a number of S&T components that together address a specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Improved techniques and information that reduces analysis uncertainty is needed for human health risk assessments. This will increase the scientific defensibility, realism of the analysis and comprehensiveness of the assessment. Improvements are needed in all four basic steps of human health risk assessments, hazard identification, exposure assessment, dose-response assessment, and risk characterization (NRC 1983). Specifically, the technical needs include:

- Appropriate biological models and transfer factors to link plant-animal contaminant conditions to availability for human intake.

- Reliable, reproducible biophysical measurement techniques that can provide quantitative indication of individual human exposures to key radionuclides and chemicals.
- Incorporation of realistic retention/clearance and distribution information in the exposure assessment, and consideration of homeostasis and the behavior of mixtures and chemical analogs.
- Modification of risk assessment methodologies to incorporate realistic exposures, dose-response and risk characterization for Hanford contaminants and regional lifestyles.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE 2000) indicates that the information is required to be implemented as part of the System Assessment Capability, Revision 2. Information that improves health assessments, increases defensibility of the results, and provides a more comprehensive assessment is required for decisions associated with remediation activities for the next CERCLA review of Interim Records of Decision (~FY 2005 timeframe).

Problem Description: This need falls under the Risk Technical Element within the S&T Endeavor. The Risk Technical Element will provide an assessment of the potential risks to the environment, human health, economic, and socio-cultural quality of life from Hanford-derived contaminants. Human health risk assessment includes the four steps mentioned above, and the needs address technical improvements in each step as well as modifications to the methodology to address Hanford specific issues. The need addresses human health links to the environment, cultures and social systems. Fulfilling the need will improve the scientific defensibility, realism of the analysis and comprehensiveness of human health assessments at the Hanford Site and throughout the DOE complex.

Benefit to the Project Baseline of Filling Need: Filling this need will improve the human health risk assessment methodology at Hanford. The issues that are brought up by decision-makers, regulators and the stakeholder community will be better addressed, and the credibility of human health assessments will improve.

Functional Performance Requirements: The application of the knowledge gained through the performance of the specific needs must address the contaminants and human health scenarios that are applicable here at Hanford. The information must result in a better understanding of the uncertainty in current assessments and address upcoming changes in guidelines and regulations.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.: TIP-0016

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is insufficient information to support realistic, comprehensive human health risks at Hanford. The needs address technical issues to increase the scientific defensibility of exposures assessments to the diversity of people within the region and dose-response assessments of the complexity of contaminants at Hanford. In the absence of the information addressed in this need there is high uncertainty in current human health risk assessments

Regulatory: This need addresses the desire of Hanford regulators to assess future human uses of the Hanford Site and upcoming changes to EPA guidelines and Washington State's Model Toxics Control Act. The information obtained by addressing the need will provide an improved technical basis for making decisions.

Environmental Safety & Health: This need specifically addresses environmental safety and health issues across the Hanford Site.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: This science need supports cultural and stakeholders concerns to address human health and comprehensive impacts that were expressed in "Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment" (DOE 1998). In addition, this need also supports recent concerns expressed in the area of assessing alternative dose-response relationships to low-dose radiation effects.

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

DOE, 1998, *Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment*, DOE/RL-96-16, Revision 1, U.S. Department of Energy, Richland, Washington.

United States Department of Energy. 2000. *Groundwater/Vadose Zone Integration Project Science and Technology Summary Description*. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

NRC, 1983, *Risk Assessment in the Federal Government: Managing the Process*, National Research Council, National Academy Press, Washington, D.C.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

ESTABLISHING TECHNICAL BASIS FOR SOCIO-ECONOMIC RISK ASSESSMENTS

Identification No.: RL-SS45

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Establishing Technical Basis for Socio-Economic Risk Assessments

Need/Opportunity Category: Technology Need.

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of the water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need summarizes a number of S&T components that together address a specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

This need outlines improved techniques and information required for the inclusion of economic risk to the decision-making process. Economic impacts can occur directly from changes in human and ecological health due to exposure to contamination, or impacts can occur indirectly due to “ripple effects” from the former impacts. Economic impacts do not result until risks are perceived. The first step is to determine at what point does the level of environmental risk begin to influence the behavior of people such as

consumers, producers, recreational fisherman, and sailboarders, for example. The points, or trigger mechanisms, are then applied to examine how the potential exposure of the environment to Hanford-derived contaminants influences economic market and non-market behavior as well as social activities. Specific activities for this need include the following:

- Improved methods are needed to predict how residents, recreationists, consumers of agricultural products and other stakeholder groups process and respond to information concerning risks posed by environmental contamination.
- Techniques and information that accurately quantify Columbia River-based recreation and other social values are needed to calibrate economic and health effects models.
- Process-oriented non-monetary cardinal and ordinal metrics need to be developed so that the competing preferences for non-market resources or alternative ecological scenarios for mitigation can be evaluated and ranked by the various stakeholder groups and a best alternative could be identified for each.
- Improved benefit transfer methodology for developing estimates of economic benefit associated with specific natural or non-market resources are needed.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE 2000) indicates that the information is required to be implemented as part of the System Assessment Capability, Revision 2, and therefore need to be completed by FY 2004.

Problem Description: This need falls under the Risk Technical Element within the S&T Endeavor. The Risk Technical Element will provide an assessment of the potential risks to the environment, human health, economic and socio-cultural quality of life from Hanford-derived contaminants. Economic assessments have begun to appear in EPA's publications on environmental decision-making (EPA 1999) and stakeholders have requested the inclusion of this information for their participation in Hanford activities (DOE 1998). At this time there is little understanding of the triggers for economic impacts, and even less understanding of the non-market resource evaluations. This need addresses methodologies for better understanding economic risk at the Hanford Site and surrounding areas.

Benefit to the Project Baseline of Filling Need: Filling the gap in knowledge associated with Hanford-derived contaminants and economic impact parameters will decrease the uncertainty attached to the economic risk assessment results in the System Assessment Capability. There is a clear indication that economic risk assessment will be used in decision making. Hanford Site stakeholders have indicated that economic risk is required for consideration in decisions about the site (DOE 1998) and EPA's Science Advisory Board has included economic risk in a recent publication on uncertainty and decision-making.

Functional Performance Requirements: This need must be addressed by providing the technical basis for trigger mechanisms in the economic risk assessment process.

Work Breakdown Structure (WBS) No.: 1.4.03.4.4

TIP No.: TIP-0016

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is currently insufficient knowledge of how the potential exposure of Hanford-derived contaminants influences economic market and non-market behavior as well as social activities. This science need addresses collection of information to be used in future economic assessments

Regulatory: Economic assessments are indirectly related to regulatory requirements at the Hanford Site. Information obtained by addressing this need will provide more information for making site regulatory decisions.

Environmental Safety & Health: This need is indirectly related to environmental safety and health issues in that the consequences of activities that jeopardize safety and health will result in economic impacts.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: There is great concern in the stakeholder community to include economic risk in Hanford Site remedial decisions. This need addresses the social and economic assessment requirements that were expressed in “Columbia River Comprehensive Impact Assessment, Part II: Requirements for a Columbia River Comprehensive Impact Assessment” (DOE 1998).

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

References:

DOE, 1998, *Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment*, DOE/RL-96-16, Revision 1, U.S. Department of Energy, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

EPA, 1999, Integrated Environmental Decision-Making in the 21st Century, Report from the EPA Science Advisory Board’s Integrated Risk Project, EPA-SAB-EC-99-018, Peer Review Draft, May 3, 1999, U.S. Environmental Protection Agency, Washington, D.C.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

MODELING RISK KNOWLEDGE

Identification No.: RL-SS46

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3]

TSD Title: N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC
- _____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- _____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Modeling Risk Knowledge

Need/Opportunity Category: Technology Need.

Need Description: This need addresses specific technical gaps identified in the scope of the Groundwater/Vadose Zone Integration Project (Integration Project) at the Hanford Site and is written as an “integrated” need. The Integration Project is focused on providing the scientific and technical basis to ensure that Hanford Site decisions, including decisions related to long-term stewardship, are defensible and possess an integrated perspective for the protection of the water resources, the Columbia River, river-dependent life, and users of the Columbia River resources. As such, this “integrated” need summarizes a number of S&T components that together address a specified technical gap. Individual efforts applied to resolve the technical gaps described in this need may address all or part of the components identified for this need. Where a specific technology need can be defined separately from an “integrated” need, a specific technology need statement has been written and is included elsewhere in the Hanford Site STCG Subsurface Contamination Needs (e.g., RL-SS25: Improved, Cost-Effective Methods for Subsurface Access to Support Characterization and Remediation).

Socio-cultural risk assessment methodology is just beginning to be addressed by risk assessors, risk managers and decision-makers. The methods and approaches are poorly defined at this time. There are data gathering activities that are being defined and addressed in other endeavors within the Groundwater/Vadose Zone Integration Project to collect preliminary information on identification of affected communities, understanding the environmental values of these communities, evaluating cultural landscapes, and performing quality of life studies. The scientific need is to collect this information into a

model or models that can be used to integrate all risk elements in a form that communicates effects of the Hanford Site today and into the future with the concerned communities.

This need recognizes that knowledge is socially constructed. Successor socio-cultural studies will lay the epistemological foundation for understanding how the various affected cultural communities organize knowledge relative to risk. There is a need to take those findings and produce an integrated risk perception model. The model will be essential for finding common intellectual ground, which is essential for building partnerships in dealing with Hanford Site waste. The creation of these partnerships is essential for reducing risk uncertainty and bias. These partnerships should include all culturally affected communities and decision-makers.

Addressing this need requires integrating findings from other social and cultural studies regarding the major variables and variable relationships that exist among the members of the concerned communities. The major research question to be addressed is the extent to which these variously based community variables and relationships can be simultaneously modeled or whether they are mutually irreconcilable.

To address this need, one or more integrated risk models must be developed to serve as a foundation for explaining past community behaviors with regards to risk and predicting future responses to changes in the Hanford environment.

Specifically, the need is to:

- Develop integrated risk models that will serve as a foundation for explaining past community behaviors with regards to risk and predicting future responses to changes in the environment from the waste remaining at Hanford upon site closure.
- Develop tools for communicating integrated risk to regional communities and decision-makers. These tools have to provide real-time response to the “what-if” scenarios that would be addressed in communication of risk at stakeholder/decision-maker meetings.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/05

The Integration Project S&T roadmap (DOE 2000) indicates that the information is required to be implemented as part of the System Assessment Capability, Revision 2. As mentioned above, there are basic data gathering activities that must be completed prior to addressing this need. Development of the integrated risk knowledge models should begin shortly after the data gathering activities identify the affected communities.

Problem Description: This need falls under the Risk Technical Element within the S&T Endeavor. Socio-cultural risk assessment is being addressed in the Groundwater/Vadose Zone Integration Project because of a growing recognition that the conventional risk assessment paradigm does not address all of the things that are “at risk” in communities facing the prospect of contaminated waste sites or permitted chemical or radioactive releases. There is a need for developing integrated models to incorporate the information of concern to affected communities and provide tools that will be used to communicate the results of the model to them and decision-makers.

Benefit to the Project Baseline of Filling Need: Filling this need will help provide socio-cultural risk that is technically defensible. However, this need can not be addressed until other characterization activities are completed.

Functional Performance Requirements: This need addresses the integration of risks to the environment, human health, economic impacts and socio-cultural impacts. The analysis must provide information on how affected communities relate to Hanford contamination. This information will be used by decision-makers to focus remediation activities and stewardship responsibilities.

Work Breakdown Structure (WBS) No. : 1.4.03.4.4

TIP No.:

Relevant PBS Milestone: PBS-MC-042

Justification For Need:

Technical: There is currently inadequate understanding of how cultural communities in the region will react to Hanford contamination in the future. Improved information is needed to allow decision makers to better communicate the risks that might occur in the future.

Regulatory: Information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions.

Environmental Safety & Health: Safety and health are the primary concerns within modeling risk knowledge.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is \$200M. This estimate is based on an assumed savings of 5% of the total Hanford remediation life-cycle cost of >\$5B. Estimated savings are due to information and data gained by filling this need that supports decisions for cost effective remediation and long-term stewardship.

Cultural/Stakeholder Concerns: The need directly relates to the cultural and stakeholder concerns of clean up at Hanford and the future of the site. The integration of their concerns within the overall risk communication process will assist in successful decision making.

Other: None.

Current Baseline Technology: N/A

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

Reference:

BHI, 1999, *Groundwater/Vadose Zone Integration Project Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management*, Letter Report, Richland, Washington.

United States Department of Energy. 2000. Groundwater/Vadose Zone Integration Project Science and Technology Summary Description. DOE/RL-98-48, Vol. III, Rev. 1, U.S. Department of Energy, Richland, Washington.

FY 2002 SUBSURFACE CONTAMINANTS

SCIENCE NEEDS

SCIENCE NEED STATEMENT

DETECTION/DISTRIBUTION OF CONTAMINANTS--CHEMICAL SPECIATION AND COMPLEXATION IN SITE-SPECIFIC GROUNDWATERS

Identification No.: RL-SS23-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Detection/Distribution of Contaminants--Chemical Speciation and Complexation in Site-specific Groundwaters

Need/Opportunity Category: Science Need

Need Description: Determine the speciation and complexation of contaminants of interest in an aqueous phase distributed in (1) the vadose zone (pristine and contacted by tank waste liquids) and (2) the aquifer.

In order to detect and delineate the distribution of contaminants accurately in different media in a variety of hydrogeological settings at Hanford (e.g. vadose zone, aquifer), several aspects of science need to be addressed. It is important for design and selection of remedial alternatives to determine the inventory of the different contaminants at a given contaminated site: what contaminants are present, in what different forms, and in what amounts. The in-situ chemical speciation of important contaminants (listed in the background section) as a function of the hydrochemical conditions of the Site is important to determining which dissolution/precipitation or oxidation/reduction reactions will immobilize or release contaminants. Measures are needed for solubilities of the different species as a function of the concentration of important cations and anions in uncontaminated and contaminated groundwater. While speciation can be modeled from bulk groundwater analyses, some direct measure of speciation, such as optical or emission spectroscopy, is needed to confirm models and assist in establishing contaminant mass balance. Basic scientific information on speciation contributes to the assessment of remedial alternatives.

Science needs also include knowing the range of aqueous complexes that contaminants form with common groundwater cations and anions, such as whether or not contaminants can be expected to occur as hydroxides, carbonates, sulfates, oxyanions, or as organic complexes. Knowledge of the solubility limits for these species in site-specific groundwaters assists in determining if aqueous complexes form surface complexes with secondary mineral surfaces.

A secondary need for information on contaminant speciation and complexation supports the development of accelerated analytical methods that can provide data on in-situ chemistry remotely and non-invasively. Some of the constraints include the need for these approaches to be remote, real-time, and either on-line or in-situ methods.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: The Hanford Site is underlain by a vadose zone that ranges from less than 40 feet thick at the 100 Areas near the Columbia River to greater than 300 feet thick at the 200 Area. Recharge rates in pristine parts of the site are very low. Liquid waste disposal within the vadose zone has introduced numerous sources of contamination to the soil pore waters. High-level waste tanks have leaked varying amounts of sodium nitrate-hydroxide liquids contaminated with soluble radionuclides such as cesium and technetium. The chemistry of groundwater in the vadose zone will reflect the heterogeneity of waste streams that have been disposed. Likewise, the suprabasalt sediments beneath the Hanford site have several different facies, and therefore varying mineralogical, chemical, and hydraulic properties. The nature of the chemical reactions in this hydrogeologic setting will be specific to the types of pore waters, contamination, and primary/secondary minerals encountered, and data for the specific species and complexes encountered are a necessary prerequisite to adequate design of remedial technologies.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative technologies may be developed and deployed to enhance the rate of remediation of the groundwater plumes at the Hanford site. Use of in-situ remedial technology rather than ex-situ treatment will reduce risk and provide cost savings

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS28

Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

DETECTION/DISTRIBUTION OF CONTAMINANTS--CHEMICAL BINDING ON SITE-SPECIFIC MINERAL SURFACES

Identification No.: RL-SS24-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Detection/Distribution of Contaminants--Chemical Binding on Site-Specific Mineral Surfaces

Need/Opportunity Category: Science Need

Need Description: For Hanford site conditions, determine the reactions that will affect the binding of contaminants in solution on secondary mineral surfaces, and on primary phases, if relevant.

The binding of contaminants on secondary mineral surfaces occurs primarily through adsorption. Adsorption processes affect potentially all metals and organics, and occur primarily with selected adsorbing surfaces (i.e., Fe and Mn oxides, clay minerals, humics, microbial cells). Science needs for a better understanding of adsorption include the need to incorporate the effects of surface heterogeneity into macroscopic models of adsorption. To better determine the effects of competitive adsorption processes and ligand complexation, it is necessary to have free energy relations for surface adsorption processes. Many of these properties require that measurements be made on ideal surfaces and surfaces with selected defects for mechanistic studies of surface heterogeneity. When microbial processes are important, it will be important to determine the stabilities of microbial exopolymers and the complexes it forms with metal ions. Research is needed to characterize the chemical composition of microbially-produced metal-binding ligands, which are large, chemically heterogeneous biomolecules. Potentially metal/radionuclide binding selectivity can be related to microbial ligand chemical composition, which may in turn be developed into remedial alternatives.

Geochemically and microbially mediated processes such as precipitation/dissolution affect all the metals of interest with the possible exception of mercury and technetium. Many of the contaminants of interest are abiotically precipitated, with the possible exception of uranium. Microorganisms can also participate either actively or passively in the precipitation or dissolution of metals (e.g., production of CO₂, sulfide from respiration). Additional science is needed to describe the incorporation of trace components into important mineral phases; such information supports assessment of how trace components be selectively removed by remediation. When there is microbial reductive dissolution of oxide minerals, it becomes important to know the fate of trace components that are released.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Significant geologic heterogeneity exists in the suprabasalt sediments underlying Hanford production facilities, and the unconfined aquifer at Hanford occurs in two different formations. The aquifer beneath facilities sited near the Columbia river occurs within flood gravels of the Hanford Formation; beneath the 200 area, the aquifer occurs within coarse- to medium sands and gravels of the Ringold Formation. The secondary mineralogy of these units differs, with significant amounts of 2:1 layer silicates in the finer-grained members of the Ringold Formation and fewer layer silicates in the Hanford Formation. The types of mineral surfaces will include edge sites on layer silicates.

Benefit to the Project Baseline of Filling Need: The science needs for understanding contaminant binding enable the development of in-situ remedial schemes that can replace existing pump/treat approaches.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS28

Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

DETECTION/DISTRIBUTION OF CONTAMINANTS--CHEMICAL FORM AND MOBILITY OF DENSE, NON-AQUEOUS PHASE LIQUIDS IN HANFORD SUBSURFACE

Identification No.: RL-SS25-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Detection/Distribution of Contaminants--Chemical Form and Mobility of Dense, Non-Aqueous Phase Liquids in Hanford Subsurface

Need/Opportunity Category: Science Need

Need Description: For Hanford vadose zone and aquifer, determine the chemical form and mobility of dense, non-aqueous phase liquids such as chlorinated solvents in contact with (1) pore water and groundwater, (2) secondary minerals.

Free-phase DNAPL can constitute a major secondary contaminant source so its chemical form and mobility need to be established. Science needs include the solubility and speciation of DNAPL in Hanford groundwaters, as well as the possibility of free product DNAPL. Constitutive properties (e.g. interfacial tension, entry pressure) of multiple fluids (air, water, free product DNAPL) are needed to model the form and potential mobility of DNAPLs in the subsurface. The interaction of DNAPL with mineral surfaces or with naturally occurring organic matter should be determined to gain additional information on chemical form. The subsurface itself is physically heterogeneous at a variety of scales; this heterogeneity must be incorporated in any model of DNAPL mobility and is addressed by another science need, Effect of Subsurface Heterogeneities on Chemical Reaction and Transport (RL-SS29-S). Key science needs on DNAPL form and mobility also include determining how NAPLs are distributed with regard to specific pore geometries and how the physical setting affects their extractability. Additional

information is also needed about the role of surfactants and other agents on the basic physical properties (solubility, interfacial tensions) of NAPLs or dissolved organics and how these relations can be exploited to mobilize such contaminants. Science is also needed to extend the theoretical and computational basis for the physics of subsurface multiple phase fluid flow and transport, a corollary science need, Mathematical Formulations of Chemical Reaction/Material Transport (RL-SS31-S).

Subsurface processes which can lead to the in-situ degradation or transformation of the chemical form of DNAPLs can include abiotic or biotic dechlorination. In-situ remediation requires knowledge of the mechanisms and rates of these processes. Different remedial options will incorporate different science needs. For example, selection of a bioremediation option that uses metabolic dechlorinating microorganisms requires knowledge of (1) subsurface microbial ecology (whether dechlorinators are present or must they be introduced), (2) microbial nutrient requirements, (3) biochemistry of dechlorination (e.g. electron donors, metabolic pathways and rates, byproducts, enzymology), and (4) bacterial injection/transport issues (e.g. biofouling, exopolymer production). Selection of a remedial option that uses manipulation of aquifer oxidation-reduction potential to cause dechlorination requires knowledge of (1) aquifer hydraulics, (2) mechanisms and rates for electron transfer reactions involving aquifer minerals, and (3) colloid mobilization/transport issues. Other subsurface processes can lead to the enhanced mobilization or immobilization of contaminants in the subsurface. For example, in the case of carbon tetrachloride, for example, science needs include (1) cosolvency of carbon tetrachloride in aquifer organic matter or introduced materials (e.g. surfactants, alcohol, vegetable oil), and (2) effects of surfactants on carbon tetrachloride mobility (e.g. viscosity, interfacial tension). Knowledge of the sorption capacity of the ion exchange resin can also be used to improve current pump/treat methods.

To understand DNAPL mobility, it may also be necessary to detect the location of DNAPLs, and remote interrogation methods require additional refinement. Science needs based for subsurface detection of DNAPL include identifying which properties of the DNAPL and the subsurface sediments will provide the most indicative signal of DNAPL presence. Seismic signals can be used to locate DNAPL; knowledge of the effects of site-specific physical and chemical properties on seismic attenuation can assist in determining if such interrogation methods are viable. Knowledge of the chemical composition of the disposed DNAPL may allow use of chemical tracers that can be used to constrain DNAPL location. Combining measurement techniques with a numerical model of DNAPL migration in the subsurface can further constrain its location.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: There is known contamination of groundwater in the vadose and saturated zones at the 200 West Area by carbon tetrachloride, a dense non-aqueous phase liquid (DNAPL). Current remedial actions for groundwater plumes include pumping contaminated water from the aquifer and treating it with an air-stripping action followed by vapor-phase GAC polishing. An Expedited Response Action (ERA) is being conducted to remove carbon tetrachloride from the soil beneath the operable unit; vapor extraction is currently being used in the ERA, but a final remedial strategy has not yet been developed to mitigate the soil contamination at 200-PW-1. The current approach of using ex-situ ion exchange treatment of contaminated water and air is considered to be relatively expensive and the length of time required to operate the system to meet functional requirements is not well constrained because of uncertainty associated with data used in models of ex-situ treatment. In situ treatment of the contaminants may result in reduced costs for remediation, but requires reduction of the uncertainty associated with the chemical form and mobility of DNAPLs in the subsurface.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative technologies may be developed and deployed to locate and remediate subsurface DNAPL acting as a long-term source for groundwater contamination. Knowledge of chemical form and mobility make it possible to design the necessary remedial approach. Rapid location of DNAPL leads to the ability to plan and implement appropriate remedial technologies.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS31

Understand and quantify the relationship between contaminant sources, vadose zone plume properties and groundwater plume properties with a focus on the groundwater-vadose zone interface.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

TRANSPORT OF CONTAMINANTS-- REACTION RATES FOR KEY CONTAMINANT SPECIES AND COMPLEXES IN SITE- SPECIFIC GROUNDWATERS

Identification No.: RL-SS26-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Transport of Contaminants-- Reaction Rates for Key Contaminant Species and Complexes in Site- Specific Groundwaters

Need/Opportunity Category: Science Need

Need Description: For Hanford site conditions, determine the reaction rates and the key reaction steps that control the speed with which a contaminant changes chemical form (e.g. speciation, complexation) and/or interacts with the surfaces of secondary minerals. For waste streams associated with implemented restoration technologies, establish the important reactions and associated rates of contaminant transformation.

Kinetic treatments of groundwater chemistry are usually required for chemical systems where reactions are slow, irreversible, or heterogeneous. The rates of reactions between minerals and groundwater are difficult to predict because of the dependence of the rate on the surface characteristics of the mineral grains, any adsorbed trace substances, and the possible presence of microorganisms that could catalyze reactions. Reactions of interest will involve reactions between mineral surfaces and an aqueous solution. Science needs include direct determination of the rates of reactions for Hanford contaminants on secondary minerals important in Hanford subsurface environments, e.g. iron oxyhydroxides, calcium carbonates, or 2:1 layer silicates such as smectite or vermiculite or illite.

The mechanisms and reaction rates for the adsorption of metals and ligands on mineral surfaces are required. The role of surface reaction control vs. transport reaction control on specific reactions will be important. Groundwater systems in the Hanford and Ringold formations contain variable amounts of primary minerals such as plagioclase, quartz, and mafics associated with basaltic fragments which are thermodynamically unstable at low temperatures. Rates of primary mineral dissolution and secondary mineral precipitation are needed, as well as geochemical models for the incorporation of trace contaminants (metals, radionuclides) into secondary phases via co-precipitation.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Growth of contaminant plumes and their response to remedial actions both involve the transport of contaminants, which in turn depends on the interplay between hydraulics of subsurface systems and groundwater chemistry. The dissolved species concentrations in many groundwater systems may remain constant with time, implying either equilibrium or steady-state chemical conditions, controlled by slow dissolution/precipitation or adsorption/desorption reactions. Detailed analyses of such systems can reveal that many of the chemical reactions that occur consist of initially fast and then slower reaction steps, with the latter reactions being strongly affected by diffusion of species. For many species, ions must diffuse into the matrix of sediments before binding by adsorption or incorporation by secondary mineral precipitation can occur. Knowledge of the reaction rates within the aquifer system must be combined with information on hydraulic properties to understand plume growth and mobility in such environments, which is prerequisite to remedial technology selection and design. Once a technology is implemented, it becomes important to know both the reaction mechanisms and the rates of reactions that control the transformation of the contaminant, in order to assess accurately the longevity of remedial treatments.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then accurate information is available for use in tools associated with the design and selection of appropriate remedial technologies. Using accurate geochemical models of subsurface contaminant reactions assists in the design of technologies that address the problem in a timely fashion with minimal impact on human health and the environment.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS28

Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

TRANSPORT OF CONTAMINANTS-- RATES OF COUPLED ABIOTIC AND BIOGEOCHEMICAL REACTIONS INVOLVING CONTAMINANTS IN HANFORD SUBSURFACE

Identification No.: RL-SS27-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Transport of Contaminants-- Rates of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface

Need/Opportunity Category: Science Need

Need Description: For Hanford site conditions, determine the effect on contaminant form (e.g. speciation/complexation/reaction) of coupling important abiotic and biogeochemical reactions for which independent rates of reaction are known.

In systems where reaction coupling may occur, it becomes important to determine how movement of a fluid of reactive components affects oxidation/reduction, aqueous and surface complexation, precipitation/dissolution, and interphase mass transfer. Coupling with convective and dispersive transport processes may result in different reaction pathways for the system, and science is needed to quantify these effects. Science is needed to understand the response of the biogeochemical system to the presence of zones ranging from transport-limited to reaction rate-limited conditions. Multiphase transport in heterogeneous media may need to be incorporated in a broader understanding of a subsurface system. It will be important to establish how the biogeochemical system behaves under remediation stresses (chemical, hydraulic, thermal, phase changes).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Numerous abiotic and biogeochemical reactions occur in complex geochemical systems. Individual rates can be determined in laboratories; in natural settings, these rates may not adequately describe the behavior of contaminant plume because coupling between chemical reactions and transport processes occurs. Depending on groundwater velocities, reactions that are transport-controlled may become more or less favored in the natural setting, and relative contributions of different reactions to buffering the chemical system could change. The potential for coupling of abiotic and biogeochemical reactions for Hanford contaminants must be assessed as part of selection of appropriate remedial alternatives.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then the relative importance of transport limitations vs. reaction-rate limitations for important Hanford plumes will be known and incorporated into appropriate remedial technologies. Such information could affect the selection of technologies because the rate information is important to technology performance.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS28

Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

TRANSPORT OF CONTAMINANTS-- RATES OF COLLOID FORMATION AND COLLOIDAL TRANSPORT OF CONTAMINANTS IN SITE-SPECIFIC GROUNDWATERS

Identification No.: RL-SS28-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Transport of Contaminants-- Rates of Colloid Formation and Colloidal Transport of Contaminants in Site-Specific Groundwaters

Need/Opportunity Category: Science Need

Need Description: For Hanford site conditions, determine what secondary minerals form as colloids in groundwater, determine the importance of biosorption, and establish the nature of the chemical interactions between contaminants of interest and the surfaces of inorganic and organic colloids.

The physical and chemical behavior of colloids in the subsurface can dramatically affect how the contaminants are transported, so it becomes important to know if Hanford subsurface environmental conditions are conducive to the formation of stable suspensions of mobile colloids. Science needs include the determination of mechanisms and rates of production of inorganic and organic colloids in Hanford groundwaters, the rates of adsorption of contaminants onto colloids, and the effect of colloid-facilitated transport on contaminant migration. In those part of the aquifer where there may be subsurface microbial communities, issues of microbial transport become important. Science needs also include the determination of important controls on biosorption of contaminants and bacterial/ colloid transport processes (e.g., the role of microbial transport processes such as growth, active attachment to surfaces, filtration by pores, settling within pores, on the ultimate dispersal and distribution of biosorbed contaminants).

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Colloid-facilitated transport is not uncommon in the movement of low solubility contaminants in arid environments. Radionuclides such as plutonium have been demonstrated to move on silicate colloids at other arid sites, and organic contaminants can be adsorbed or co-solvated with both naturally-occurring and synthetic organic colloids. Metals can be adsorbed on inorganic colloids, complexed by organic colloids, or adsorbed on microbial surfaces. Such colloids are often charge-neutral and travel more quickly through groundwater systems than ions or complexes. Such behavior must be accounted for in the design and selection of appropriate remedial technologies.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then understanding of the role of colloid-facilitated transport in the dispersal of Hanford contaminants will be possible. Better knowledge of the subsurface chemical systems supports selection of the most appropriate remedial technologies for the types of plumes being remediated.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS29

Understand, quantify, and develop descriptions of contaminant transport in the vadose zone.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042*End-User:* Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

TRANSPORT OF CONTAMINANTS-- EFFECT OF SUBSURFACE HETEROGENEITIES ON CHEMICAL REACTION AND TRANSPORT

Identification No.: RL-SS29-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- X 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Transport of Contaminants-- Effect of Subsurface Heterogeneities on Chemical Reaction and Transport

Need/Opportunity Category: Science Need

Need Description: Determine how the physical and chemical properties of the specific Hanford formations affect the transport of chemical solutes and colloids.

The science needed to elucidate the role of physical and chemical heterogeneities on subsurface transport of solutes and colloids can be focused on both (1) developing a more thorough understanding of the relative contributions of these heterogeneities to contaminant transport through controlled experimentation, and (2) rapidly and accurately characterizing the presence of these heterogeneities. Key science issues related to how physical properties affect transport include determining the effect of multidomain pore structures on solute, NAPL, and other contaminant transport rates under controlled pressure gradients, determining the role of pore structure on the movement of water in unsaturated porous media, and relating this information to convective and diffusive transport of contaminants. Key scientific issues related to the coupling of chemical reaction to physical transport include accounting for changes in the hydraulics due to precipitation/dissolution and/or biomass accumulation/destruction, determining the availability of sites for surface complexation based on chemical changes in the mineral surface area, and representing fully coupled bioreactive transport processes, where constituent reactions affect transport properties and vice versa.

Science is needed to characterize physical and chemical heterogeneity rapidly and remotely. Most remote sensing technologies (e.g. ground-penetrating radar, shallow seismic, electromagnetics) are sensitive to differences in the physical properties of the subsurface, such as sediment density, moisture content, physical structure, and clay content. Many of the technologies are also sensitive to thickness of different sediment layers or to depth of signal penetration into sediment. Science needs to address these issues include developing detection methods that provide adequate signal penetration and reflection/refraction and account for sediment moisture, grain size, and clay content. Science is needed to determine chemical information in situ as well.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Subsurface environments are heterogeneous in their physical and chemical properties at a variety of scales. Heterogeneities in surface areas of minerals can have significant impacts on reaction rates, whereas heterogeneous distributions of formation permeability affects transport velocities. Knowledge of how heterogeneous physical and chemical properties affect chemical solute and colloidal transport is important to the design of appropriate remedial technologies.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative technologies may be developed and deployed to enhance the rate of remediation of different types of plumes. Use of in-situ remedial technology rather than ex-situ treatment will reduce risk and provide cost savings

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS29

Understand, quantify, and develop descriptions of contaminant transport in the vadose zone.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

TRANSPORT OF CONTAMINANTS-- REMEDIAL TECHNOLOGY FOR CS BENEATH WASTE TANKS

Identification No.: RL-SS30-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Transport of Contaminants-- Remedial Technology for Cs Beneath Waste Tanks

Need/Opportunity Category: Science Need

Need Description: For migration of Cs beneath Hanford waste tanks, determine the reaction rates affecting cesium adsorption on micaceous secondary minerals exposed to chemical conditions similar to those generated by leaking high-level waste.

Current geochemical understanding of the adsorption of cesium-137 on secondary micaceous minerals is based on measurements of phenomenological distribution coefficients in systems with a dilute aqueous phase. There are no direct measurements of the adsorption reactions of cesium on Hanford micaceous materials that have been exposed to solutions with high concentrations of base, salt, and aluminate. Science is needed to develop an improved understanding of the ion-exchange and surface adsorption processes affecting cesium on micaceous minerals in the presence of solutions similar to high-level tank wastes. Science is also needed to develop an accurate geochemical model that describes the molecular mechanisms and rates of cesium adsorption on micaceous minerals as a function of relevant solution and solid phased properties. These data are needed to design and select an appropriate remedial technology for cesium migration in the Hanford unsaturated zone.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: High-level wastes generated during special nuclear material production at the Hanford Site were stored in 177 underground storage tanks. Many of the single-shelled tanks have leaked, discharging up to 1 million gallons of waste to the subsurface. Much of the radioactivity in the leaking wastes is ascribed to highly soluble constituents, such as cesium-137. Cesium-137 generally adsorbs strongly to the types of micaceous secondary minerals found in the Hanford subsurface.

However, the wastes themselves have high concentrations of base (hydroxyl), aluminate, sodium, and nitrite/nitrate. These wastes are likely to react with Hanford subsurface minerals, causing dissolution and reprecipitation of material. The reactions of the waste on Hanford subsurface micaceous materials may be affecting the geochemical behavior of radiological constituents such as cesium-137. Preliminary characterization data for the unsaturated zone beneath SX tank farm in Hanford's 200 West area suggests the effect is to cause significant remobilization of cesium-137 to deeper sections of the subsurface profile. Information is needed to assess the velocity of cesium-137 in the unsaturated zone beneath Hanford tanks.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative technologies may be developed and deployed to remediate cesium migration in the Hanford unsaturated zone. Use of in-situ remedial technology rather than ex-situ treatment will reduce risk and provide cost savings

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:
RL- SS28

Understand, quantify and develop descriptions of reactions and interactions between contaminants of concern and vadose zone sediments.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

REMEDATION--MATHEMATICAL FORMULATIONS OF CHEMICAL REACTION/MATERIAL TRANSPORT

Identification No.: RL-SS31-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remediation--Mathematical Formulations of Chemical Reaction/Material Transport

Need/Opportunity Category: Science Need

Need Description: For site conditions, contaminant chemistry and reactivity, and hydraulic properties at Hanford, formulate the chemistry and physics needed to describe the dispersal and longevity of subsurface contaminant plumes.

Key scientific issues for the mathematical formulation of coupled multicomponent reactions and mass transfer include methods for incorporating and accommodating very different rates of chemical transformation (e.g. milliseconds to microseconds for homogenous acid -base transformations, to seconds to hours for adsorption/desorption reactions, to years for isotopic exchange or certain mineral-water reactions.) Science needs include determining the formulation of chemical reaction when coupled with steady-state and transient velocity fields for physical transport at a variety of length scales. Such needs point out the requirement of understanding the relationship among processes that occur on different temporal and length scales. Scaling is often addressed empirically. To incorporate information across a variety of temporal and spatial scales, it is important to know the physical and temporal scales at which biogeochemical processes, particularly nonlinear processes, occur in heterogeneous media. This need relates to the need for characterizing physical and chemical heterogeneity in the subsurface (RL-SS29-S: Transport of Contaminants--Effect of Subsurface Heterogeneities on Chemical Reaction and Transport), and determining the appropriate statistical descriptors of properties important to prediction of reactive

transport at the field-scale. Science is also needed to improve the speed, accuracy, and resolution of codes that model multicomponent three-dimensional bioreactive transport processes.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: As part of the design and selection of remedial technologies, the longevity and performance of different remedial alternatives will be addressed. Simple engineering models exist to assess technology performance. The assumptions of subsurface physical and chemical homogeneity, of chemical equilibrium, and of steady-state hydraulics in these models result in large uncertainties in the computed assessments of technology performance. Once remedial technologies are implemented, the longevity and performance of the technology can be monitored through direct measurements of the associated transformations of contaminants. The use of monitoring data in conjunction with accurate physical and chemical models of technology behavior will substantially increase the accuracy of longevity predictions. Improved accuracy of physical and chemical models of the processes involved in the technology will also require knowledge of the effect of spatial and temporal process scales.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, the appropriate mathematic formulations of physical and chemical subsurface processes will be available for use in design and development of remedial alternatives. The longevity and performance of different remedial technologies can be screened to assure the best in-situ remedial technology or ex-situ treatment will be implemented at reduced risks to workers and at cost savings to the government.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS29

Understand, quantify, and develop descriptions of contaminant transport in the vadose zone.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

REMEDIATION--REACTIVITY OF ORGANICS IN THE HANFORD SUBSURFACE

Identification No.: RL-SS32-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- X 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remediation--Reactivity of Organics in the Hanford Subsurface

Need/Opportunity Category: Science Need

Need Description: For naturally occurring organic matter and synthetic organic compounds in the Hanford subsurface, determine the rates of degradation reactions that supply energy to subsurface biological consortia that participate in dechlorination of halogenated solvents.

The biodegradation of halogenated organic compounds (TCE, PCE, DCE, TCA, DCA--CCl₄, PCBs--primarily anaerobic) and metal/radionuclide organic complexes (EDTA, ED3A, citrate--aerobic or anaerobic) requires knowledge of the biochemical mechanisms/enzymes involved in the transformations. Potentially, the halogenated organic compounds undergo reductive dehalogenation by anaerobic bacteria. It will be important to determine the molecular phylogeny of these organisms and how they interact physiologically to degrade halogenated organics. The kinetics of the individual reactions must be known to determine whether pathways/enzymes can be engineered to overcome kinetic limitations. Science needs also include determining the electron donors that drive microbial dehalogenation and the stoichiometries required for complete dehalogenation of chlorinated organic compounds. For biodegradation of chelating agents, it will be important to know the speciation of contaminants with these agents, the metabolic pathways and enzymes involved, and the molecular basis for the substrate selectivity exhibited by transport and catabolic enzymes. Likewise, it will be important to determine the fate of the radionuclide or metal after the organic moiety has been degraded.

Scientific issues associated with the nature of in-situ microbial consortia and their potential role in the transformation of contaminants include knowing the endogenous rates of microbial metabolism and how they relate to contaminant attenuation. It will be important to determine the spatial distributions of microorganisms, the composition of the microbial community and its nutrient requirements, and the in-situ microbial degradative capabilities in order to understand the scale, range, and distribution of kinetic rates for contaminant degradation. Science will be required to address whether the chemical composition of the aqueous phase could be manipulated to facilitate the desired reactions in situ.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Natural organic matter constitutes a fraction of the minerals in most subsurface hydrogeologic environments. Synthetic organic compounds, such as organic acids or chelating agents, and chlorinated solvents, also occur in contaminated parts of the subsurface. These compounds can undergo biodegradation by subsurface microbial communities. The biodegradation of the different compounds occurs at varying rates, and in the case of certain chlorinated hydrocarbons, involves cometabolic processes. The reactivity of these organics depends on the chemistry of the groundwater system (oxic, anoxic) and the nature of the subsurface microbial consortia and its degradative abilities.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative technologies may be developed and deployed to enhance the rate of remediation of different organic compounds in the subsurface. Use of in-situ remedial technology rather than ex-situ treatment will reduce risk and provide cost savings

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

REMEDATION--INTERACTION OF REMEDIAL PROCESSES WITH HANFORD SUBSURFACE

Identification No.: RL-SS33-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- X 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remediation--Interaction of Remedial Processes with Hanford Subsurface

Need/Opportunity Category: Science Need

Need Description: For technologies implemented under Hanford conditions, determine the interactions and reactions between materials used in the remedial process, and dissolved, adsorbed, and/or precipitated contaminants associated with native mineral surfaces.

For different implemented or proposed technologies, there will be information required to address the effect of the remediation process on the environment. Currently implemented technologies include pump/treat systems for the ex-situ removal of carbon tetrachloride from groundwater, and pump/treat systems for the reduction of chromate in groundwater. Technologies under testing and evaluation for possible implementation include redox manipulation of the subsurface using sodium dithionite. Science needs include the measurement of reaction rates involving contaminants being remediated and those solids, liquids, and/or gases introduced as part of remedial technologies.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Many of the remedial alternatives under consideration for implementation at Hanford require the manipulation of subsurface conditions, either passively as in the emplacement of zeolite containment barriers or actively as in pump/treat solutions or manipulation of the oxidation/reduction potential of the aquifer. The materials that will be introduced to the Hanford subsurface may have a noticeable effect on the existing steady-state chemistry. The types of interactions and their mechanisms and rates must be established to assess the effect on dissolved, adsorbed, or coprecipitated contaminant species. Likewise any competition for mineral surface sites must be examined.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then a more accurate estimation of the performance and effectiveness of different alternative technologies may be assessed, supporting selection of the safest and most cost-effective remediation. More in-situ remedial technologies potentially could be implemented, thereby reducing human health risk and providing cost savings.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS01

Cost-effective, In-situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

RL- SS03

Improved, Real-time, In-situ Detection of Carbon Tetrachloride in Groundwater

RL- SS04

Cost-effective, In-situ Remediation of Hexavalent Chromium in Groundwater

RL- SS06

Improved, Real-time, In-situ Detection of Hexavalent Chromium in Groundwater

RL- SS07

Cost-effective, In-situ Remediation of Strontium-90 in Groundwater

RL- SS09

Improved, Real-time, In-situ Detection of Strontium-90 in Groundwater

RL- SS11

Cost-effective, In-situ Remediation in the Vadose Zone of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, Lead

RL- SS12

Cost-effective, In-situ Remediation in the Vadose Zone of One or More of the Following Radionuclides: uranium, plutonium, cesium, cobalt, and strontium-90

RL- SS15

Improved, In-situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, Lead

RL- SS16

Improved, In-situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Radionuclides: uranium, plutonium, cesium, cobalt, and strontium-90

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

REMEDIATION--SELECTIVITY FOR CONTAMINANTS IN THE HANFORD SUBSURFACE

Identification No.: RL-SS34-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remediation--Selectivity for Contaminants in the Hanford Subsurface

Need/Opportunity Category: Science Need

Need Description: For Hanford site conditions, determine those chemical reactions that can select among contaminants and be used to separate contaminants from contaminated groundwaters and soils.

Selectivity for different contaminants in soil and groundwater depends on the speciation and complexation of each contaminant, the types of reactions that change the chemical form on the contaminant (e.g. dissolution/precipitation, adsorption, oxidation/reduction), and the nature of the other contaminants in the mixture. Science needs include the identification of natural or engineered chemical reactions within aquifer systems that can serve to separate different contaminant classes in the aqueous and in the solid phases, determining speciation and complexation for the contaminants, and measuring rates of the reactions of interest. These data can then be used to propose and evaluate technologies that could be used to selectively remediate contaminants.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Many sites at Hanford are contaminated with several different classes of chemicals, such as radionuclides, metals, and organic compounds. Mixtures of these contaminants are common. It is possible that remediation of a chemically complex site may require the implementation of multiple technologies. It will be important to assess whether the technology proposed for remediation one class of compound affects the behavior of another class of compounds. For example, if treatment of one compound to immobilize it results in the accelerated mobility of another class of compound, then these effects must be recognized prior to technology implementation. Sufficient information is needed to assess the synergistic effects of technology and to design selective treatments if warranted. The technical issue associated with this science need is the ability to implement chemistry that selects among contaminants in soil and groundwater.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative technologies may be developed and deployed to enhance the remediation of contaminant mixtures. Use of in-situ remedial technology rather than ex-situ treatment will reduce risk and provide cost savings.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS01

Cost-effective, In-situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

RL- SS03

Improved, Real-time, In-situ Detection of Carbon Tetrachloride in Groundwater

RL- SS04

Cost-effective, In-situ Remediation of Hexavalent Chromium in Groundwater

RL- SS06

Improved, Real-time, In-situ Detection of Hexavalent Chromium in Groundwater

RL- SS07

Cost-effective, In-situ Remediation of Strontium-90 in Groundwater

RL- SS09

Improved, Real-time, In-situ Detection of Strontium-90 in Groundwater

RL- SS11

Cost-effective, In-situ Remediation in the Vadose Zone of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, Lead

RL- SS12

Cost-effective, In-situ Remediation in the Vadose Zone of One or More of the Following Radionuclides: uranium, plutonium, cesium, cobalt, and strontium-90

RL- SS15

Improved, In-situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, Lead

RL- SS16

Improved, In-situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Radionuclides: uranium, plutonium, cesium, cobalt, and strontium-90

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

MONITORING OF CONTAMINANTS-- USE OF CHEMICAL SURROGATES FOR CONTAMINANTS

Identification No.: RL-SS35-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Monitoring of Contaminants-- Use of Chemical Surrogates for Contaminants

Need/Opportunity Category: Science Need

Need Description: To assess potential migration of difficult-to-measure contaminants in the Hanford subsurface, select relevant chemical analogues (similar group, charge, ionic size, physical state) to contaminant of interest that can be measured by existing measurement technologies.

Science needs include the identification of adequate surrogates for the contaminants of interest including gaseous or vapor forms of contaminants. Given an adequate surrogate, it is then important to determine the types, mechanisms, and rates of reactions involving those surrogates, and the incorporation of such reactions into performance assessment tools. Given information on the speciation, complexation, and reactions affecting surrogates, the concentrations of the surrogates can be measured and used as estimators of the concentrations of hard-to-measure contaminants

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: The chemical analysis of certain radiological or metallic constituents in Hanford subsurface plumes are difficult and time- intensive to perform, making monitoring of the performance of different remedial technologies very expensive. For some classes of compounds, analogues have been identified based on chemical form, charge, and ionic size. These analogs can simulate species in solids, solutions, or the vapor phase. The properties of these analogues are often similar to the contaminant of interest and the analogues have the advantage of being either easier or safer to measure. Existing technologies for chemical analysis make it possible to implement field monitoring for the analogs more readily than for the contaminants. The question arises as to the extent of similarity of the behavior of the analogue and the contaminant; the technical issue related to the science need is to demonstrate the adequacy of measuring the analogue to understand the behavior of the contaminant.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then alternative measurements of technology performance can be made to trace the effectiveness of the remediation. Use of in-situ monitoring technology rather than ex- situ analysis may be possible, and will reduce risk and provide cost savings over full laboratory analyses needed for some radiological contaminants.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:
RL- SS29

Understand, quantify, and develop descriptions of contaminant transport in the vadose zone.

RL- SS30

Provide means to delineate contaminant plumes in the vadose zone and relate plume distribution to the distribution of geochemical and hydrogeological properties.

RL-SS34

Provide means to quantify the flux of contaminant between the groundwater and the Columbia River.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

MONITORING OF CONTAMINANTS-- CHEMICAL INDICATORS OF REMEDIAL TECHNOLOGY PROCESSES

Identification No.: RL-SS36-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- ☒ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☐ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Monitoring of Contaminants-- Chemical Indicators of Remedial Technology Processes

Need/Opportunity Category: Science Need

Need Description: For Hanford site-specific conditions, identify the species that form during a remedial technology process (chemical, physical, and/or biological) and are indicative of key reactions that make the technology work. Determine concentrations of key species that represent the endpoint(s) of the technology process.

Science needs include measuring the rates of reactions fundamental to the operation of remedial technologies, and identifying the species and concentration indicative of the endpoint of the reactions and therefore the remedial processes. Information is needed for current remedial approaches and for those approaches being demonstrated at pilot scale, such as in-situ redox manipulation to reduce contaminants such as chromate, uranium, and chlorinated hydrocarbons.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Some of the remedial technologies that are identified for implementation at Hanford call for the introduction of chemical or biological materials to the subsurface. These materials

will cause reactions in the groundwater system that are aimed at reducing or transforming the contaminant plumes. To assess performance of the remedial technologies and determine whether an endpoint has been reached, measurements of different chemical species will be made. Feasibility studies for remedial alternatives will have identified key important reactions for the different technologies. It will be important to know which species are indicative of endpoints for the chemical reactions involved in the technology. For example, if reduction and immobilization of chromate to chromium (IV) is part of a remedial technology, it will be important to know when the concentration of chromate drops below the necessary target level as an indication that the end of the process has been reached.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then it will be possible to design and implement a post-closure monitoring plan that adequately assesses technology performance and can be used to determine when a remediation is complete. Use of in-situ monitoring technology for endpoint concentrations will reduce risk to human health and provide cost savings.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:

RL- SS01

Cost-effective, In-situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

RL- SS03

Improved, Real-time, In-situ Detection of Carbon Tetrachloride in Groundwater

RL- SS04

Cost-effective, In-situ Remediation of Hexavalent Chromium in Groundwater

RL- SS06

Improved, Real-time, In-situ Detection of Hexavalent Chromium in Groundwater

RL- SS07

Cost-effective, In-situ Remediation of Strontium-90 in Groundwater

RL- SS09

Improved, Real-time, In-situ Detection of Strontium-90 in Groundwater

RL- SS11

Cost-effective, In-situ Remediation in the Vadose Zone of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, Lead

RL- SS12

Cost-effective, In-situ Remediation in the Vadose Zone of One or More of the Following Radionuclides: uranium, plutonium, cesium, cobalt, and strontium-90

RL- SS15

Improved, In-situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, Lead

RL- SS16

Improved, In-situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Radionuclides: uranium, plutonium, cesium, cobalt, and strontium-90

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHL, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHL, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

SCIENCE NEED STATEMENT

MONITORING OF CONTAMINANTS-- CHEMICAL SENSOR PRINCIPLES

Identification No.: RL-SS37-S

Date: September 2001

Program: Environmental Restoration

OPS Office/Site: Richland Operations Office/Hanford Site

Operable Unit(s): Broad need potentially applicable to multiple operable units.

PBS No.: RL-SS04 (RL-VZ01)

Waste Stream: Groundwater (Disposition Map Designation: ER-10 [technical risk score 5] and ER-18 [technical risk score 5]), Soil (Disposition Map Designations: ER-04 [technical risk score 3], ER-14 [technical risk score 5], ER-03 [technical risk score 3])

TSD Title:

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: N/A

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority: Select a "1", "2" or "3" to assess the impact of the need/opportunity relative to the current site baseline.

- X 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Monitoring of Contaminants-- Chemical Sensor Principles

Need/Opportunity Category: Science Need

Need Description: Establish the physics and chemistry principles that underlie more accurate, more sensitive, and higher resolution measurements of contaminant concentrations in the aqueous and solid (surface) phases

Science needs include obtaining a better understanding of the physics and chemistry that will lead more accurate, more sensitive, and higher resolution measurements. Theory from the fields of electronics, electrical engineering, microfluidics, and chemical physics can be examined for their ability to provide innovative measurement technology.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Problem Description: Monitoring technology performance requires the ability to measure contaminant concentrations in liquids and solids in a timely, safe manner either in-situ or in-line. Currently there are very few highly accurate in-situ or in-line sensors for contaminants of interest. Innovative probes based on fundamental principles are needed to address the gap.

Benefit to the Project Baseline of Filling Need: If the science needs are filled, then it will be possible to make high-speed, accurate, high-resolution analyses of different contaminant species in-situ. These new sensors will reduce risk to human health and provide cost savings.

Benefit code: check all that apply:

- ✓ Cost Savings
- ✓ Risk Reduction
- ✓ Enabling Knowledge (i.e., solves a problem that cannot be remediated by current science/technology)

This Science Need also supports the following Hanford Subsurface Contaminant Technology Needs:
RL- SS31

Understand and quantify the relationship between contaminant sources, vadose zone plume properties and groundwater plume properties with a focus on the groundwater-vadose zone interface.

Relevant PBS Milestone: PBS-MC-042

End-User: Richland Environmental Restoration Project

Site Technical Point-of-Contact: Scott W. Petersen, BHI, (509) 372-9126; Mark D. Freshley, PNNL, (509) 372-9568; Michael J. Truex, PNNL, (509) 376-5461

Contractor Facility/Project Manager: Michael J. Graham, BHI, (509) 372-9179

DOE End-User/Representative Point-of-Contact: John G. Morse, DOE-RL, (509) 376-0057

**FY 2002 SUBSURFACE CONTAMINANTS
TECHNOLOGY NEEDS STATEMENT CROSSWALK**

Old ID# (FY01)	New ID # (FY02)	Needs Title	Changes in FY 2002 Revision	PBS #
RL-SS01	RL-SS01	Cost-Effective, In-Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater	Updated to include natural attenuation possibility and update ITRD status	RL-CP01
RL-SS02		Improved, Real-Time, In-Line Detection of Carbon Tetrachloride in Process Water	Deleted	
RL-SS03	RL-SS03	Improved, Remote, In Situ Detection of Carbon Tetrachloride in Groundwater	Updated to include vadose zone monitoring	RL-CP01
RL-SS04	RL-SS04	Cost-Effective, In Situ Remediation of Hexavalent Chromium in Groundwater	Minor updates	RL-RC01
RL-SS23		Improved, Ex Situ Remediation of Chromium in Groundwater	Deleted	
RL-SS05		Improved, Real-Time, In-Line Detection of Hexavalent Chromium in Process Water	Deleted	
RL-SS06	RL-SS06	Improved, Remote, In Situ Detection of Hexavalent Chromium in Groundwater	Minor updates	RL-RC01
RL-SS07	RL-SS07	Cost-Effective, In Situ Remediation of Strontium-90 in Groundwater	Updated to include natural attenuation possibility and update ITRD status	RL-RC01
RL-SS08	RL-SS08	Improved, Real-Time, In-Line Detection of Strontium-90 in Process Water	Minor updates (references, schedule dates)	RL-RC01
RL-SS09	RL-SS09	Improved, Remote, In Situ Detection of Strontium-90 in Groundwater	Minor updates	RL-RC01
RL-SS10	RL-SS10	Improved Technologies for Detection/Delineation of Burial Ground Contents and Waste Site Boundaries	Updated per 618-10/11 burial ground information and other minor updates	RL-RC01; RL-RC02; RL-CP01; RL-RS01
RL-SS11	RL-SS11	Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone	Minor updates (references, schedule dates)	RL-RC01
RL-SS12	RL-SS12	Cost-Effective, In Situ Remediation in the Vadose Zone Radionuclides	Minor updates	RL-RC01; RL-RC02; RL-CP01
RL-SS24		Improved Ex Situ Treatment of Soils Contaminated with Lead and Other TCLP Metals	Deleted	
RL-SS13	RL-SS13	Improved, Real-Time Field Screening During Excavation for Heavy Metals with emphasis on the Following: Lead, Chromium, Mercury, and Barium	Minor updates	RL-RC01; RL-RC02

Old ID# (FY01)	New ID # (FY02)	Needs Title	Changes in FY 2002 Revision	PBS #
RL-SS14	RL-SS14	Improved, Real-Time Field Screening During Excavation for Radionuclides with emphasis on the Following: Uranium, Plutonium, Strontium-90, and Technitium-99	Minor updates	RL-RC01; RL-RC02; RL-CP01
RL-SS15	RL-SS15	Improved, In Situ Characterization and Monitoring of Soil Contamination by Heavy Metals and Other Ions	Minor updates	RL-RC01; RL-RC02; RL-CP01
RL-SS16	RL-SS16	Improved, In Situ Characterization and Monitoring of Soil Contamination by Radionuclides	Minor updates	RL-RC01; RL-RC02; RL-CP01
RL-SS17	RL-SS17	Long-Life Waste Isolation Surface Barrier	Some updates	RL-CP01
RL-SS18	RL-SS18	Improved Handling and Segregation of TRU Waste (Debris)	Updated per 618-10/11 burial ground information	RL-CP01; RL-RS01
RL-SS19	RL-SS19	Detection, Handling and Treatment of Pyrophoric Materials in Burial Grounds	Minor updates (references, schedule dates)	RL-RC02; RL-RS01
RL-SS20	RL-SS20	Improved Methods for Debris Handling and Segregation	Minor updates (references, schedule dates)	RL-RC01; RL-RC02; RL-RS01
RL-SS25	RL-SS25	Improved, Cost-Effective Methods for Sub-Surface Access to Support Characterization and Remediation.	Minor updates	RL-SS04; RL-RC01; RL-RC02; RL-CP01; RL-RC01
RL-SS26	RL-SS26	Improved Methods for Determining Distribution of Beta Emitting Contaminants in Subsurface Soils	Minor updates	RL-RC01; RL-CP01; RL-SS04
RL-SS47	RL-SS47	Cost-effective, In Situ Remediation of Uranium in Groundwater	Minor updates (references, schedule dates)	RL-CP01
	RL-SS48	Remote Handling During Excavation Of TRU And High Dose Materials From Burial Grounds	New Need; added stakeholder comment "The primary concern related to this need is ensuring the safety of workers, the public, and the environment during burial ground remediation operations."	RL-RS01
	RL-SS49	Contamination control during excavation activities	New Need; added stakeholder comment "The primary concern related to this need is ensuring the safety of workers, the public, and the environment during burial ground remediation operations."	RL-RS01

Old ID# (FY01)	New ID # (FY02)	Needs Title	Changes in FY 2002 Revision	PBS #
	RL-SS50	Waste segregation and packaging for TRU and high dose rate contaminated material	New Need; added stakeholder comment "The primary concern related to this need is ensuring the safety of workers, the public, and the environment during burial ground remediation operations."	RL-RS01
RL-SS27	RL-SS27	Use of Field Data from Representative Sites to Elucidate Controlling Features and Processes for Contaminant Distribution	Minor updates (references, schedule dates)	RL-SS04
RL-SS28	RL-SS28	Understand, Quantify And Develop Descriptions Of Reactions And Interactions Between Contaminants Of Concern And Vadose Zone Sediments	Minor updates (references, schedule dates)	RL-SS04
RL-SS29	RL-SS29	Develop descriptions of contaminant flow and transport in the vadose zone	Minor updates (references, schedule dates)	RL-SS04
RL-SS30	RL-SS30	Understand And Quantify Water Movement In The Vadose Zone Using Uncontaminated Field Sites	Minor updates (references, schedule dates)	RL-SS04
RL-SS31	RL-SS31	Provide Advanced Characterization Tools And Methods To Delineate Contaminant Plumes In The Vadose Zone And Relate Plume Distribution To The Distribution Of Geochemical And Hydrogeological Properties	Minor updates (references, schedule dates)	RL-SS04
RL-SS32	RL-SS32	Understand And Quantify The Relationship Between Contaminant Sources, Vadose Zone Plume Properties And Groundwater Plume Properties At Hydrologic Boundaries With A Focus On The Groundwater-Vadose Zone Interface	Minor updates (references, schedule dates)	RL-SS04
RL-SS33	RL-SS33	Provide Means To Delineate Regional Groundwater Plumes In Three Dimensions And Define A Scientific Basis For Addressing Scaling Issues In Hanford Groundwater	Minor updates (references, schedule dates)	RL-SS04
RL-SS34	RL-SS34	Understand, Quantify And Develop Descriptions Of Biogeochemical Reactions And Interactions Between Contaminants Of Concern And Aquifer Sediments To Describe Biochemical Reactive Transport	Minor updates (references, schedule dates)	RL-SS04
RL-SS35	RL-SS35	Provide Means To Quantify The Flux Of Contaminant Between The Groundwater And The Columbia River	Minor updates (references, schedule dates)	RL-SS04

Old ID# (FY01)	New ID # (FY02)	Needs Title	Changes in FY 2002 Revision	PBS #
RL-SS36	RL-SS36	Provide Means To Integrate Regional-Scale Phenomena Into Assessments Of Contaminant Transport And Impacts Within The Columbia River.	Minor updates (references, schedule dates)	RL-SS04
RL-SS37	RL-SS37	Provide Methodology To Relate Information Derived From Sitewide-Scale Groundwater Flow Modeling To The Various Scales Associated With Assessing Impacts In The River Environment	Minor updates (references, schedule dates)	RL-SS04
RL-SS38	RL-SS38	Understand, Quantify And Develop Descriptions Of Transport And Transformation Of Groundwater-Derived Contaminants Of Concern In The River	Minor updates (references, schedule dates)	RL-SS04
RL-SS39	RL-SS39	Understand And Provide Means To Quantify The Impacts Of River Contamination On Receptors	Minor updates (references, schedule dates)	RL-SS04
RL-SS40	RL-SS40	Provide A Method To Develop Mass Balance (i.e., Holistic) Inventory Estimates.	Minor updates (references, schedule dates)	RL-SS04
RL-SS42	RL-SS42	Provide Method For More Accurate Estimates Of Waste Constituent Release Rates And Modes From Waste	Minor updates (references, schedule dates)	RL-SS04
RL-SS43	RL-SS43	Improvements to Ecological Risk Assessments and Analysis of Population-level Impacts	Minor updates (references, schedule dates)	RL-SS04
RL-SS44	RL-SS44	Improvements to Human Health Risk Assessments	Minor updates (references, schedule dates)	RL-SS04
RL-SS45	RL-SS45	Establishing Technical Basis for Socio-Economic Risk Assessments	Minor updates (references, schedule dates)	RL-SS04
RL-SS46	RL-SS46	Modeling Risk Knowledge	Minor updates (references, schedule dates)	RL-SS04
RL-SS23-S	RL-SS23-S	Detection/Distribution of Contaminants – Chemical Speciation and Complexation in Site-Specific Groundwaters	Update PBS #	RL-SS04
RL-SS24-S	RL-SS24-S	Detection/Distribution of Contaminants – Chemical Binding on Site-Specific Mineral Surfaces	Update PBS #	RL-SS04
RL-SS25-S	RL-SS25-S	Detection/Distribution of Contaminants – Chemical Form and Mobility of Dense, Non-Aqueous Phase Liquids in Hanford Subsurface	Update PBS #	RL-SS04
RL-SS26-S	RL-SS26-S	Transport of Contaminants – Reaction Rates for Key Contaminant Species and Complexes in Site-Specific Groundwaters	Update PBS #	RL-SS04

Old ID# (FY01)	New ID # (FY02)	Needs Title	Changes in FY 2002 Revision	PBS #
RL-SS27-S	RL-SS27-S	Transport of Contaminants – Rates of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface	Update PBS #	RL-SS04
RL-SS28-S	RL-SS28-S	Transport of Contaminants – Rates of Colloid Formation and Colloidal Transport of Contaminants in Site-Specific Groundwaters	Update PBS #	RL-SS04
RL-SS29-S	RL-SS29-S	Transport of Contaminants – Effect of Subsurface Heterogeneities on Chemical Reaction and Transport	Update PBS #	RL-SS04
RL-SS30-S	RL-SS30-S	Transport of Contaminants – Remedial Technology For CS Beneath Waste Tanks	Update PBS #	RL-SS04
RL-SS31-S	RL-SS31-S	Remediation – Mathematical Formulations of Chemical Reaction/Material Transport	Update PBS #	RL-SS04
RL-SS32-S	RL-SS32-S	Remediation – Reactivity of Organics in the Hanford Subsurface	Update PBS #	RL-SS04
RL-SS33-S	RL-SS33-S	Remediation – Interaction of Remedial with Hanford Subsurface	Update PBS #	RL-SS04
RL-SS34-S	RL-SS34-S	Remediation – Selectivity for Contaminants in the Hanford Subsurface	Update PBS #	RL-SS04
RL-SS35-S	RL-SS35-S	Monitoring of Contaminants – Use of Chemical Surrogates for Contaminants	Update PBS #	RL-SS04
RL-SS36-S	RL-SS36-S	Monitoring of Contaminants—Chemical Indicators of Remedial Technology Processes	Update PBS #	RL-SS04
RL-SS37-S	RL-SS37-S	Monitoring of Contaminants – Chemical Sensor Principles	Update PBS #	RL-SS04

WASTE MANAGEMENT PROGRAM

FY 2002 SCIENCE AND TECHNOLOGY NEEDS STATEMENTS

WASTE MANAGEMENT PROGRAM

SCIENCE NEEDS

FY 2002 WASTE MANAGEMENT TECHNOLOGY NEEDS INDEX

ID #	Need Title	PBS #
RL-MW01	Remote Macroencapsulation of RH MLLW Debris	RL-CP02
RL-MW02	Remotely Controlled Size/Volume Reduction Techniques for RH MLLW and RH TRUW	RL-CP02
RL-MW04	Remote Decontamination of RH TRUW Debris to Support Reclassification into Non-TRUW Category	RL-CP02
RL-MW05	Remote Treatment of RH Soils and Other Solid Wastes Contaminated with Organics	RL-CP02
RL-MW06	Treatment of CH TRUW Liquid Wastes Contaminated with PCBs and Ignitables	RL-CP02
RL-MW013	Non-Destructive Assay (NDA) of RH TRUW (High Beta/Gamma field) to meet WIPP Requirements	RL-CP02
RL-MW014	Technology to Dispose of 12 Drums of Pu238 (500 g/drum)	RL-CP02
RL-MW016	System to Retrieve RH TRUW from Caissons	RL-CP02
RL-MW017	Treatment of MLLW Batteries	RL-CP02
RL-MW018	Treatment of MLLW Mercury Wastes	RL-CP02
RL-MW020	Solidification of High Salt Wastes	RL-CP02
RL-MW021	Control of Equipment Corrosion Caused by Chloride	RL-CP02
RL-MW022	Identification and Control of Biological Foulants	RL-CP02
RL-MW023	Tritium Removal from Wastewater	RL-CP02
RL-MW025	Non-Destructive Assay (NDA) of CH TRUW to Meet WIPP Requirements for Burial Boxes - Certification of Boxed Waste Assay System (BWAS)	RL-CP02
RL-MW026	Getter for Hydrogen	RL-CP02
RL-MW027	Chemical Analysis to Meet WIPP Waste Acceptance Requirements	RL-CP02
RL-MW029	Non-Destructive Assay of Large Buried Containers	RL-CP02
RL-MW030	Plutonium Contamination Control Large Container Load-In/Load-Out Systems	RL-CP02
RL-MW031	Long-Length Contaminated Equipment Disposal	RL-CP02
RL-MW032	Category 3 MLLW Disposal	RL-CP02
RL-MW033	Processing Waste for Shipment to WIPP	RL-CP02
RL-MW034	Drum Venting	RL-CP02
RL-MW035	Application of Supercompaction to CH-TRU Waste	RL-CP02
RL-MW036	Treatment of RH TRU Sludges Such as Waste Coming out of K Basins Storage Pools	RL-CP02
RL-MW037	Non-Destructive Evaluation of RH Waste	RL-CP02
RL-MW038	Iodine-129 Characteristics	RL-CP02

ID #	Need Title	PBS #
SCIENCE NEEDS		
RL-MW07-S	Non-Intrusive, Non-Destructive Characterization Methods for Hazardous Chemical Components of Mixed Low-Level Waste	RL-CP02

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE MACROENCAPSULATION OF RH MLLW DEBRIS

Identification No.: RL-MW01

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3469 – Macroencapsulation Feed, and 3490 – M91 Feed

TSD Title: 173 – M-91 Facility, 175 – Macroencapsulation, and 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Remote Macroencapsulation of RH MLLW Debris.

Need/Opportunity Category: *Technology Need* --There is no existing or currently identified technology capable of solving the site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop and demonstrate remote macroencapsulation systems for various sizes and shapes of remote-handled (RH) debris (i.e., failed equipment) contaminated with mixed low-level waste (MLLW). Selecting a macroencapsulation technology from existing technologies may require substantial development, as well as regulatory review and/or approval.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: Technology is needed to support macroencapsulation of RH-MLLW for the M-91 Facility.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

No measurable cost savings are expected. This need is to establish method to treat a waste stream where no method currently exists.

Benefit to the Project Baseline of Filling Need: Establish method for treatment by macroencapsulation of RH-MLLW.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: The technology must be able to treat RH MLLW to meet Land Disposal Requirements (LDRs), and must have a high degree of reliability and ease of maintenance.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: Macroencapsulation technologies for various sizes of RH MLLW debris have not been developed or demonstrated (except for selected River Protection Project [RPP] long-length contaminated equipment [LLCE]).

Regulatory: The M-91 Milestone to submit a Management Plan was completed in June 1999. The plan included RH MLLW macroencapsulation. M-91 also requires that treatment be initiated by June 2008.

Environmental Safety & Health: There are occupational health concerns associated with processing RH waste.

Cultural/Stakeholder Concerns: Facilitate the cleanup effort and reduce worker exposure to radiation.

Other: None identified.

Current Baseline Technology: Macroencapsulation technology exists only for contact-handled (CH) debris and selected RPP LLCE.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	Current: 196 m ³ ; Forecasted (5 yrs): 3,481 m ³
Waste form	Large sizes and shapes of debris (e.g. failed equipment)
Waste stream I.D.	3469, 3490
Contaminants and co-contaminants	Beta and gamma radiation, EPA Codes D001-D043, F001-F005, PXXX, and UXXX
Function of technology	Treatment (meet LDR)
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTELY CONTROLLED SIZE/VOLUME REDUCTION TECHNIQUES FOR RH MLLW AND RH TRUW

Identification No.: RL-MW02

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1566 – RH TRU Stored/New, and 3490 – M91 Feed

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remotely Controlled Size and Volume Reduction Techniques for RH MLLW and RH Transuranic Waste (TRUW).

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop a remotely operated size and volume reduction system for RH MLLW and TRUW items over a wide range of sizes, shapes, weights, materials of construction, and types and levels of contamination. This technology will be used to reduce the size and/or void volume associated with large debris to optimally load the Waste Isolation Pilot Plant (WIPP) shipping containers. Selecting a size and volume reduction technology from existing technologies such as cutting, shredding, compaction, or metal melting, and converting it to remote operation may require substantial development.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: There is a current inventory of 196 m³ of RH MLLW and 204 m³ of RH TRUW. An additional 3,481 m³ of RH MLLW and 1,690 m³ of RH TRUW are forecast. Furthermore, 1,672 m³ of failed equipment presently stored in the Plutonium-Uranium Extraction (PUREX) tunnel may need to be retrieved and processed. A volume-reduction technology could significantly reduce these quantities.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

Potential life cycle savings are estimated to be up to \$10,000K. A total of 1,000 cubic meters of waste is projected. Cost estimate is based on a 20 percent volume reduction of waste at \$50K per cubic meter.

Benefit to the Project Baseline of Filling Need: Allows cost-effective packaging of waste.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: Provide size/volume reduction capability for RH MLLW and RH TRUW such as cutting, shredding, compaction, and metal melting. The system should be highly reliable, and easy to maintain and clean.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: No system exists to reduce the volume and treatment cost of RH MLLW and RH TRUW debris.

Regulatory: The M-91 Milestone required submittal of a RH MLLW and a RH TRUW Project Management Plans in June 1999 and June 2000. M-91 also requires that RH MLLW treatment be initiated by June 2008 and RH TRUW treatment initiated by June 2005.

Environmental Safety & Health: There are occupational health concerns associated with processing RH waste.

Cultural/Stakeholder Concerns: Facilitate cleanup and increase the cost effectiveness of the cleanup effort.

Other: None identified.

Current Baseline Technology: Treat/dispose of RH MLLW and RH TRUW without reduction in volume.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

	RH MLLW	RH TRUW
Waste volume, m ³	Existing: 196 m ³ Projected (5 years): 3,481m ³ Total: 3,679 m ³	Existing (HAN05): 204 m ³ , Existing (PUREX Tunnels): 1,672 m ³ , Projected (HAN05-5 years): 1,690 m ³ Total: 3,566 m ³
Waste form	Large sizes and shapes of debris (e.g., failed equipment)	Large sizes and shapes of debris (e.g., failed equipment)
Waste stream numbers	3490	1566
Contaminants and co-contaminants	Beta and gamma radiation; EPA Codes D001-D043, F001-F005, PXXX, and UXXX	Alpha, beta, and gamma radiation
Function of technology	Volume Reduction	Volume reduction
Source category	Various Hanford Programs	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE DECONTAMINATION OF RH TRUW DEBRIS TO SUPPORT RECLASSIFICATION INTO NON-TRUW CATEGORY

Identification No.: RL-MW04

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1566 – RH TRU Stored/New, 3490 – M-91 Feed

TSD Title: 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Remote Decontamination of RH TRUW Debris to Support Reclassification into LLW Category.

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Another approach to the volume reduction of RH TRUW materials is to decontaminate the waste items. The objective is to remove the TRU contamination to a level acceptable for disposal as contact-handled (CH) TRUW or LLW. In addition, some decontaminated materials may be reused. Remote decontamination techniques may require substantial development as well as regulatory review and/or approval.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: The anticipated sources of RH TRUW are the long-length contaminated equipment (LLCE) from Hanford site high-level waste (HLW) tanks (pumps, jumpers, and other ancillary equipment), the tank waste disposal program, and R&D (research and development) waste.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Potential life cycle savings are estimated to be up to \$5,000K. A total of 1,000 cubic meters of waste is projected. Cost estimate is based on a 10 percent volume reduction of waste at \$50K per cubic meter.

Benefit to the Project Baseline of Filling Need: Potential cost savings from reducing volume of TRU waste.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: The decontamination system for RH TRU must effectively remove radionuclides from the debris and generate minimal amount of secondary waste, preferably in the solid form. Decontamination processes that produce liquid secondary waste streams would be inconsistent with the Sitewide effort to eliminate liquid waste. The system/equipment should have a high degree of reliability and must be easy to maintain and clean.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: Remote handling decontamination for large heavy items does not exist, and a system needs to be developed.

Regulatory: The M-91 Milestone which included a TRU/TRUM project management plan was completed June 2000, and specified a target date of September 2005 for award of commercial contracts to process RH and large-size TRU/TRUM.

Environmental Safety & Health: There are occupational health concerns associated with processing RH waste.

Cultural/Stakeholder Concerns: Increase the cost-effectiveness of the cleanup. Recycle and/or reuse materials and equipment.

Other: None identified

Current Baseline Technology: RH TRU waste will not be decontaminated to remove radionuclides that could allow RH TRU waste to be disposed at WIPP as CH TRU or re-categorized as non-TRU.

End-User: Waste Management

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	Existing (HAN05): 204 m ³ Existing (PUREX Tunnels): 1,672 m ³ Projected (HAN05-5 years): 1,690 m ³ Total: 3,566 m ³
Waste form	Large sizes and shapes of debris (e.g. failed equipment)
Waste stream I.D.	1566
Contaminants and co-contaminants	High alpha, beta, and gamma radiation
Function of technology	Decontamination
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE TREATMENT OF RH SOILS AND OTHER SOLID WASTES CONTAMINATED WITH ORGANICS

Identification No.: RL-MW05

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3486 – Feed to Commercial Thermal Treatment, 3490 – M-91 Feed

TSD Title: 173 – M-91 Facility, 206 M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

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☐ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, <u>and</u> may reduce uncertainty in ACPC project success. |
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Need Title: Remote Treatment of RH Soils and Other Solid Wastes Contaminated With Organics.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop technologies to treat RH soils and other granular materials contaminated with hazardous organic compounds. Low-cost remote thermal or non-thermal treatment methods will be needed to process the waste to meet the land disposal restrictions (LDR). Adding the remote handling capability to existing or emerging organic treatment technologies will require substantial development.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: Small volumes of RH waste containing organics are expected. Because the waste is remote handled and the volumes are low, it is unlikely that there will be a commercial capacity for treatment of the waste.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

No measurable cost savings are expected. This need is to establish method to treat a waste stream where no method currently exists

Benefit to the Project Baseline of Filling Need: Establish treatment method.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: The technology must be able to remotely handle and treat RH solids, such as organic contaminated soils, to meet LDR standards. Generation of secondary waste is discouraged and, if unavoidable, the secondary waste must be minimized and preferably be in a solid form. The technology must be acceptable to the public and the regulators. The process must have a high degree of reliability and the system must be easy to maintain and clean. The system design should allow for construction of a mobile treatment unit.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: No available technology to treat RH soils contaminated with hazardous organics.

Regulatory: The M-91 Milestone required submittal of a Management Plan in June 1999. The plan included RH soils contaminated with hazardous organics. M-91 also requires that treatment be initiated by June 2008.

Environmental Safety & Health: There are occupational and health concerns associated with storing and handling the RH MLLW organic waste.

Cultural/Stakeholder Concerns: Complete the cleanup of the Hanford Site, including small difficult waste streams.

Other: None identified.

Current Baseline Technology: At present there is no baseline plan to treat this waste. Likely technologies will be thermal treatment or an alternative organic removal or destruction technique.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	22.5 m ³
Waste form	RH MLLW soils contaminated with organics
Waste stream I.D.	3486, 3490
Contaminants and co-contaminants	Beta and gamma radiation, EPA Codes D001-D043, F001-F005, PXXX, and UXXX
Function of technology	LDR technology
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF CH TRUW LIQUID WASTES CONTAMINATED WITH PCBs AND IGNITABLES

Identification No.: RL-MW06

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3490 – M-91 Feed

TSD Title: 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Treatment of CH TRUW Liquid Wastes Contaminated With PCBs and Ignitables.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop a technology to treat organic liquid TRUW (mostly hydraulic fluids) to destroy polychlorinated biphenyls (PCB), remove the ignitable characteristic, and safely contain transuranic radionuclides. Adapting existing or emerging thermal or chemical organic destruction technologies to handle TRUW may require substantial development.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: The WIPP Waste Acceptance Criteria prohibits the disposal of TRUW that contains either PCBs or ignitable characteristics (D001) and therefore waste with these characteristics must be processed to remove the PCBs or ignitables before packaging and transporting to WIPP. The bulk of this waste is PCB-contaminated hydraulic fluids generated in 1989 from the Plutonium Finishing Plant.

If the WIPP receives an exemption for disposal of PCB-containing waste, then the need for treatment for PCBs will be eliminated. However, the need to remove any ignitable characteristics will remain.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

No measurable cost savings are expected. This need is to establish method to treat a waste stream where no method currently exists

Benefit to the Project Baseline of Filling Need: Provide treatment method for PCBs to allow disposal.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: The technology must be able to remove the ignitable characteristic from ignitable waste and must destroy PCBs to 99.9999% destruction efficiency and contain TRUW radionuclides. The technology must be readily acceptable by the regulators (as equivalent to incineration) and the public.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: No treatment capability exists for TRUW ignitable or PCB waste.

Regulatory: WIPP Waste Acceptance Criteria does not allow PCBs and ignitables. The M-91 Milestone required submittal of a RH TRUW Project Management Plan by June 2000. M-91 also requires that RH TRUW treatment be initiated by June 2005.

Environmental Safety & Health: There are occupational and health concerns associated with storing and handling the TRU waste.

Cultural/Stakeholder Concerns: Complete the cleanup of the Hanford Site, including small difficult waste streams.

Other: None identified.

Current Baseline Technology: At present there is no baseline plan to treat this waste. Likely technologies will be thermal treatment or an alternative organic destruction technique.

End-User: Waste Management.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	Current: 80 m ³ Projected (5 yrs.): 1.9 m ³
Waste form	Mostly PCB-contaminated hydraulic fluids
Waste stream I.D.	3490
Contaminants and co-contaminants	Alpha
Function of technology	Destroy PCBs and remove ignitables
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-DESTRUCTIVE ASSAY (NDA) OF RH TRUW (HIGH BETA/GAMMA FIELD) TO MEET WIPP REQUIREMENTS

Identification No.: RL-MW013

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1566 – RH-TRU Stored/New, 3490 – M-91 Feed

TSD Title: 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Non-Destructive Assay (NDA) of RH TRUW (High Beta/Gamma field) to Meet WIPP Requirements.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop NDA technology to assay RH TRUW in high beta/gamma fields that will meet WIPP requirements.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: RH-TRUW must be assayed in a WIPP-certifiable manner before transporting to WIPP.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Potential life cycle savings are estimated to be up to \$2,500K. A total of 1,000 cubic meters of waste is projected. Cost estimate is based on a 5 percent volume reduction of waste at \$50K per cubic meter.

Benefit to the Project Baseline of Filling Need: Allows cost-effective packaging of waste and reduces overall radiation dose to workers.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: The RH-TRUW non-destructive assay (NDA) capability must be able to assay TRU elements and isotopes in a high beta-gamma dose rate environment.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: Presently no certifiable NDA technology is known to exist for high beta-gamma fields.

Regulatory: The M-91 Milestone required submittal of a RH TRUW Project Management Plan by June 2000. M-91 also requires that RH TRUW treatment be initiated by June 2005.

Environmental Safety & Health: There are occupational health concerns associated with processing RH waste.

Cultural/Stakeholder Concerns: Increase the cost effectiveness of the cleanup. Meet milestones.

Other: None identified.

Current Baseline Technology: No technology currently exists for this need.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

	RH TRUW
Waste volume, m ³	Existing (HAN05): 204 m ³ Existing (PUREX Tunnels): 1,672 m ³ Projected (HAN05-5 years): 1,690 m ³ Total: 3,566 m ³
Waste form	Large sizes and shapes of debris (e.g. failed equipment)
Waste stream I.D.	1566
Contaminants and co-contaminants	High alpha, beta, and gamma radiation
Function of technology	Assay in “high” gamma radiation fields to meet WIPP requirements
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TECHNOLOGY TO DISPOSE OF 12 DRUMS OF Pu-238 (500 G/DRUM)

Identification No.: RL-MW014

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1569 – Pu-238, 3490 – M-91 Feed

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Technology to Dispose of 12 Drums of Pu-238 (500 g/drum).

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop methods to retrieve, package, treat, and dispose of 12 drums of ²³⁸Pu (500g/drum) from the Hanford Site low-level burial ground (LLBG)

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: Currently no methods exist for retrieving, packaging, and disposing of the 12 drums of ²³⁸Pu. The material is currently identified on the EM-30 Disposition Maps (alternative case) as being shipped to the Savannah River Site (SRS) for disposal, but it is uncertain if this will occur.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: No measurable cost savings are expected. This need is to establish method to treat a waste stream where no method currently exists

Benefit to the Project Baseline of Filling Need: Establish method for disposal of ²³⁸Pu.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: The systems must be capable of safely retrieving, packaging, treating, and transporting the 12 drums of ^{238}Pu for disposal.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: Currently no methods exist for treating and disposing of the 12 drums of ^{238}Pu .

Regulatory: For WIPP shipment, there is a limit of about 2 grams of ^{238}Pu per drum, due to the limit on hydrogen-generating material for disposal (TRUPACT II Safety Analysis Report).

Environmental Safety & Health: N/A

Cultural/Stakeholder Concerns: N/A

Other: N/A

Current Baseline Technology: Repackaging to meet WIPP criteria for allowable ^{238}Pu would result in approximately 2,650 drums (See Regulatory Justification above).

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	12 drums of ^{238}Pu (5.3 Kg ^{238}Pu)
Waste form	Solid
Waste stream I.D.	1569
Contaminants and co-contaminants	Alpha
Function of technology	Disposal of ^{238}Pu waste
Source category	Came from Savannah River Site

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SYSTEM TO RETRIEVE RH TRUW FROM CAISSONS

Identification No.: RL-MW016

Date: August 2000

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1566 – RH-TRU Stored/New, 3490 – M-91 Feed

TSD Title: 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility/Caissons.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- X 1. Critical to the success of the ACPC.
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: System to Retrieve RH TRUW from Caissons

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Alpha caissons are cylindrical, underground receptacles used to store RH-TRUW. This need description covers all Hanford Site Areas including the 600 Area. There are five alpha caissons in the Hanford Site 218-W-4B/200 West Area Burial Ground. The alpha caissons, located 14 ft below grade, are accessed by a 3-ft-diameter fill chute and a 1-ft-diameter ventilation shaft. A shipment, typically one to eight waste containers, would be transferred to the caissons by inverting the shipping cask and allowing the containers to fall randomly into the S-shaped fill chute. The majority of the waste was packaged in 1-gallon cans (approximately 97% of the caissons inventory), but some 5-gallon containers, 2-gallon containers, and miscellaneous hot cell equipment also were deposited in the caissons.

Based on engineering studies done to date, the preferred retrieval method is to extract the waste through the fill chute with a robotic arm. Because of the possibility of ruptured containers, loose fines, and other solid waste forms, the robotic arm must be adaptable enough to extract a wide range of shapes and sizes of solids. After bringing the waste into a portable, shielded enclosure located over the caisson, it must then be packaged and transferred to a shielded transfer cask. The waste would then be transferred to the future M-91 facility for treatment. Development of: 1) remote systems to retrieve the waste forms from the caissons, 2) screening systems to identify non-TRUW material for alternative processing, and 3) packaging systems are required.

Schedule Requirements:

Earliest Date Required: 2009

Latest Date Required: 2014

Technology needs to be established by the end of FY 2013 to support the planned retrieval of TRUW from the alpha caissons in FY 2013-2017.

Problem Description: No technology currently exists to retrieve, screen, and package RH-TRUW from the caissons for eventual treatment at the M-91 Facility.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

No measurable cost savings are expected. This need is to establish method to treat a waste stream where no method currently exists

Benefit to the Project Baseline of Filling Need:

Establish method to retrieve waste.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: Retrieval equipment must meet access limitations of caissons and be capable of remotely removing, screening and packaging various caisson RH-TRU waste forms.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: No technology currently exists to retrieve, screen, and package RH-TRUW from the caissons for eventual treatment at the M-91 Facility.

Regulatory: TRUW material to be disposed of at WIPP.

Environmental Safety & Health: There are occupational health concerns associated with retrieving, screening, and packaging RH-TRUW.

Cultural/Stakeholder Concerns: The RH-TRUW in caissons must be retrieved for treatment and proper disposal.

Other: N/A.

Current Baseline Technology: None.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	25 m ³
Waste form	RH-TRUW solids
Waste stream I.D.	1566
Contaminants and co-contaminants	Alpha, beta and gamma radiation
Function of technology	Retrieve, screen and package caisson RH-TRUW
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF MLLW BATTERIES

Identification No.: RL-MW017

Date: October 2001

Program: Mixed Waste

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3470 – Commercial Stabilization Feed

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Treatment of MLLW Batteries.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop and demonstrate a technology for treating MLLW cadmium batteries to meet LDRs. (Lead acid MLLW batteries can now be treated by macroencapsulation in accordance with an EPA interpretation issued in 2001, so they are no longer included in this technology need).

Schedule Requirements:

Earliest Date Required: (10/01/05)

Latest Date Required: 2012

Wastes are now stored under Federal Facility Compliance Agreement (FFCA) exemption from the 1-year storage prohibition granted to the U.S. Department of Energy (DOE). If the U.S. Environmental Protection Agency (EPA) removes this exemption, DOE would have 1 year to meet requirements. No schedule currently exists for removal of the storage prohibition exemption. 2012 is the current date assumed for the site being “current” on all waste treatment.

Problem Description: Currently not permitted to dispose of MLLW batteries.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: None. This technology will allow battery disposal if required, but will yield no cost savings.

Benefit to the Project Baseline of Filling Need: Provide treatment technology in event treatment is required.

Relevant PBS Milestone: N/A

Functional Performance Requirements: The technology must be able to treat MLLW batteries to meet LDR. Current non-radioactive *Resource Conservation and Recovery Act of 1976 (RCRA)* treatment requires recovery of battery metals by thermal treatment.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: Technology does not exist to treat MLLW cadmium batteries to meet LDR.

Regulatory: Currently not allowed to dispose of MLLW cadmium batteries.

Environmental Safety & Health: There are occupational and health concerns associated with storing and handling the MLLW batteries.

Cultural/Stakeholder Concerns: Disposal or treatment of batteries is an expected outcome.

Other: N/A.

Current Baseline Technology:

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	Current inventory - Two drum equivalents of cadmium batteries
Waste form	MLLW batteries
Waste stream I.D.	3470
Contaminants and co-contaminants	Cadmium, low levels of alpha, beta and gamma radiation
Function of technology	Processing (meet LDR)
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF MLLW MERCURY WASTES

Identification No.: RL-MW018

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3470 – Commercial Stabilization Feed

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: “Paths to Closure” (ACPC) priority:

	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Treatment of MLLW Mercury Wastes.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop and demonstrate a technology for treatment of CH MLLW mercury wastes to meet LDR. Two categories of mercury waste exist; high mercury subcategory waste with greater than 260 ppm Hg sludge and solids, and amalgamated mercury (approximately two-thirds of existing mercury is amalgamated, but does not meet RCRA treatment standards within the LDR.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2012

2012 is the currently established date for the Site being “current” in waste treatment.

Problem Description: The mercury waste stream does not meet established LDR treatment standards and requires treatment prior to disposal.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

No measurable cost savings are expected. This need is to establish method to treat a waste stream where no method currently exists

Benefit to the Project Baseline of Filling Need: Provide baseline process for timely treatment of mercury waste.

Relevant PBS Milestone: None

Functional Performance Requirements: The technology must be able to treat CH MLLW mercury to meet LDR.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: No DOE or commercial capability is known to exist to treat MLLW mercury.

Regulatory: The mercury waste stream does not meet established LDR treatment standards and requires treatment prior to disposal.

Environmental Safety & Health: Mercury is a hazardous material.

Cultural/Stakeholder Concerns: Disposal or treatment of CH MLLW mercury waste is an expected outcome.

Other: N/A.

Current Baseline Technology: No capability exists to treat CH MLLW mercury waste to meet LDR.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	Current - 2 m ³
Waste form	Mercury subcategory and partially amalgamated waste streams
Waste stream I.D.	3490
Contaminants and co-contaminants	Alpha, beta and gamma
Function of technology	Dispose of mercury waste
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SOLIDIFICATION OF HIGH SALT WASTES

Identification No.: RL-MW020

Date: October 2001

Program: Mixed Waste

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 2124 – 200 ETF Sludge

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: 200 Area Effluent Treatment Facility (ETF)

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Solidification of High Salt Wastes.

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: The treatment of waste water results in the generation of a secondary waste that is very high in salt concentration. These salts are mainly sulfate salts of sodium, calcium, magnesium, and potassium. These salts normally contain trace levels of inorganic hazardous constituents. Future waste from HLW tank pretreatment and vitrification will also result in significant Technetium and Iodine-129 levels in the stream. A method for the solidification of the secondary waste is needed that meets the regulatory requirements for the disposal of MLLW and LLW, along with the disposal site's WAC. The need also includes looking at waste forms that would limit migration of I-129 in the burial grounds.

Schedule Requirements:

Earliest Date Required: June 2005

Latest Date Required: June 2005

Must be implemented by June 2005, consistent with the arrival of the Waste Treatment Plant effluent.

Problem Description: The waste water being treated in the 200 Area ETF contains elevated levels of radionuclides along with organic and inorganic constituents. The organic constituents are destroyed in the ETF. The radionuclides and inorganic constituents are concentrated in the secondary waste. The secondary waste matrix consists primarily of sulfate salts including sodium, calcium, magnesium, and potassium. Depending on the waste water being treated, this secondary waste matrix contains varying levels of radionuclides and hazardous constituents. For the secondary waste to meet regulatory

requirements and WAC for the disposal site, it will be necessary for some of the ETF secondary waste to be solidified. Without solidification, the potential exists for the secondary waste to be above the LDR treatment standards.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:
Potential life cycle saving are estimated to lower disposal cost by \$1,000K.

Benefit to the Project Baseline of Filling Need: Provide final waste form for high salt waste.

Relevant PBS Milestone: N/A

Functional Performance Requirements: Cost-effective technology to solidify a waste stream with greater than 50% salt concentration.

Work Breakdown Structure (WBS) No.: 1.2.3

TIP No.: N/A

Justification For Need:

Technical: Throughput of the secondary treatment train at the ETF is reduced.

Regulatory: Meet LDR at ERDF.

Environmental Safety & Health: N/A.

Cultural/Stakeholder Concerns: N/A.

Other: Addition of excess caustic and sulfuric acid results in unnecessary costs.

Current Baseline Technology: Secondary waste is treated in the ETF by evaporation and drying to produce a powder waste form for disposal in either the ERDF or the mixed waste trench.

End-User: Waste Management Project.

Contractor Facility/Project Manager: Donald Flyckt, Fluor Hanford, Inc. (FH), (509) 372-3142, Fax (509) 372-2089, Don_L_Flyckt@rl.gov.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov; Donald Flyckt, FH, (509) 372-3142, Fax (509) 372-2089, Don_L_Flyckt@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, gallons	~10 million gal/yr of wastes to be treated
Waste form	Solids (powder) or evaporator brine
Waste stream I.D.	2124
Contaminants and co-contaminants	Technetium, I-129, others
Function of technology	Produce waste form to meet ERDF/LLBG requirements
Source category	Multiple waste water sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTROL OF EQUIPMENT CORROSION CAUSED BY CHLORIDE

Identification No.: RL-MW021

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3943 – 242-A Evaporator Process Condensate

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: 200 Area Effluent Treatment Facility (ETF).

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Control of Equipment Corrosion Caused by Chloride.

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: A method is needed to control or prevent chloride corrosion of stainless steel piping and process equipment at the ETF. Several of the waste water streams on the Hanford Site contain elevated levels of chloride. Stainless steel materials are used extensively in the ETF. Treatment of waste water with high concentrations of chloride may result in accelerated corrosion of the stainless steel components.

Schedule Requirements:

Earliest Date Required: (10/01/02)

Latest Date Required: (09/30/04)

This is an ongoing need. Desired to implement by FY 2004.

Problem Description: Stainless steel materials are subject to increased corrosion rates in the presence of chloride.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

Potential life cycle saving of \$1,000K is estimated.

Benefit to the Project Baseline of Filling Need: Extended equipment life.

Relevant PBS Milestone: N/A

Functional Performance Requirements: A method to control and measure the amount of corrosion resulting from the treatment of waste water with elevated levels of chloride.

Work Breakdown Structure (WBS) No.: 1.2.3

TIP No.: N/A

Justification For Need:

Technical: Chlorides are known to cause corrosion of stainless steel materials.

Regulatory: Waste water containing elevated levels of chloride must be treated to meet discharge requirements. No other means of treatment exists on the Hanford Site.

Environmental Safety & Health: N/A.

Cultural/Stakeholder Concerns: N/A.

Other: N/A.

Current Baseline Technology: None

End-User: Waste Management Hanford, Inc.

Contractor Facility/Project Manager: Donald Flyckt, Fluor Hanford, Inc. (FH), (509) 372-3142, Fax (509) 372-2089, [Don L Flyckt@rl.gov](mailto:Don_L_Flyckt@rl.gov).

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov); Donald Flyckt, FH, (509) 372-3142, Fax (509) 372-2089, [Don L Flyckt@rl.gov](mailto:Don_L_Flyckt@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	N/A
Waste form	Liquid
Waste stream I.D.	3943
Contaminants and co-contaminants	Chloride
Function of technology	Control chloride corrosion
Source category	Multiple waste water sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IDENTIFICATION AND CONTROL OF BIOLOGICAL FOULANTS

Identification No.: RL-MW022

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1479 – MLLW GW 100/200 Area (to ETF), 3942 – Evaporator Feed

TSD Title: TBD

Operable Unit (if applicable): N/A.

Waste Management Unit (if applicable): N/A.

Facility: 200 Area Effluent Treatment Facility (ETF)

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Identification and Control of Biological Foulants.

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Waste water resulting from the cleanup of the Hanford Site typically has elevated levels of biological material. These biological foulants have an impact on the operability of the ETF. The identification and control of these biological foulants will significantly improve the ability to treat waste water.

Schedule Requirements:

Earliest Date Required: (10/01/02)

Latest Date Required: (06/30/05)

Must be implemented by June 2005, consistent with the arrival of the Waste Treatment Plant effluent.

Problem Description: Biological foulants interfere with the operation of waste water treatment systems. These foulants need to be identified and controlled.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Zero direct cost saving is projected. Reduced downtime results in lower risk in meeting production schedules.

Benefit to the Project Baseline of Filling Need: Reduce process downtime at ETF.

Relevant PBS Milestone: N/A

Functional Performance Requirements: A system to identify when biological foulants are present in a waste water stream and a technology to control the growth of these foulants are needed.

Work Breakdown Structure (WBS) No.: 1.2.3

TIP No.: N/A

Justification For Need:

Technical: Throughput of the ETF has been affected by biological growth in the process systems.

Regulatory: Waste water containing biological foulants must be treated to meet discharge requirements. No other means of treatment exists on the Hanford Site.

Environmental Safety & Health: N/A.

Cultural/Stakeholder Concerns: N/A.

Other: N/A.

Current Baseline Technology: Waste water containing biological foulants have previously been treated in the ETF. Significant down time for equipment cleaning and maintenance was experienced and overall throughput was reduced.

End-User: Waste Management Project.

Contractor Facility/Project Manager: Donald Flyckt, Fluor Hanford, Inc. (FH), (509) 372-3142, Fax (509) 372-2089, [Don L Flyckt@rl.gov](mailto:Don_L_Flyckt@rl.gov).

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov); Donald Flyckt, FH, (509) 372-3142, Fax (509) 372-2089, [Don L Flyckt@rl.gov](mailto:Don_L_Flyckt@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	N/A
Waste form	Liquids
Waste stream I.D.	1479, 3942
Contaminants and co-contaminants	Biological foulants
Function of technology	Control biological foulants
Source category	Various waste water sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TRITIUM REMOVAL FROM WASTEWATER

Identification No.: RL-MW023

Date: October 2001

Program: Mixed Waste

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1479 – MLLW GW 100/200 Area (to ETF), 3943 – 242-A Evaporator Process

Condensate

TSD Title:

Operable Unit (if applicable): N/A.

Waste Management Unit (if applicable): N/A.

Facility: 200 Area Effluent Treatment Facility (ETF)

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Tritium Removal from Wastewater.

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the Site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Waste water is currently treated at the Hanford Site and disposed of to the soil column. Some waste water contains elevated levels of tritium. The tritium decays to acceptable levels in the groundwater. It is likely that this practice will be subject to public review during the permitting and construction of the vitrification facility. A technology to remove low levels of tritium from waste water might greatly improve the public acceptance of the efforts to clean up the Hanford Site.

Schedule Requirements:

Earliest Date Required: (10/01/02)

Latest Date Required: TBD

Problem Description: A cost-effective technology does not exist for the reduction of low levels of tritium in waste water

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: None at present. Treatment currently not required.

Benefit to the Project Baseline of Filling Need: Provide treatment technology in event that tritium removal becomes necessary.

Relevant PBS Milestone: WMH-00-006 M-26-05H Submit to EPA and Ecology an evaluation of development status of tritium treatment technology that would be pertinent to the cleanup and management of tritiated waste water (e.g., the 242-A Evaporator Process Condensate liquid effluent) and tritium contaminated groundwater at the Hanford Site.

Functional Performance Requirements: Reduce the concentration of tritium in a waste water stream from 2-3 million pCi/L to less than 20,000 pCi/L.

Work Breakdown Structure (WBS) No.: 1.2.3

TIP No.: N/A.

Justification For Need:

Technical: A cost-effective method for removing dilute amounts of tritium from water is needed.

Regulatory: N/A.

Environmental Safety & Health:

Cultural/Stakeholder Concerns: Stakeholders have recently shown increased concern with protecting the groundwater. Public sentiment may outweigh the facts that discharges are currently within allowable discharge limits and that studies have shown there is no risk to public health and safety.

Other: N/A.

Current Baseline Technology: No cost-effective technology currently exists to remove tritium from waste water streams. The ETF treatment process is not effective in removing tritium from the various waste streams it receives.

End-User: Waste Management Project.

Contractor Facility/Project Manager: Donald Flyckt, Fluor Hanford, Inc. (FH), (509) 372-3142, Fax (509) 372-2089, Don_L_Flyckt@rl.gov.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov; Donald Flyckt, FH, (509) 372-3142, Fax (509) 372-2089, Don_L_Flyckt@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, gallons	1 to 4 million gallons per year
Waste form	Liquid
Waste stream I.D.	1479, 3943
Contaminants and co-contaminants	Tritium
Function of technology	To remove tritium from water
Source category	Various waste water sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-DESTRUCTIVE ASSAY (NDA) OF CH TRUW TO MEET WIPP REQUIREMENTS FOR BURIAL BOXES - CERTIFICATION OF BOXED WASTE ASSAY SYSTEM (BWAS)

Identification No.: RL-MW025

Date: October 2001

Program: Mixed Waste

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 2121 – CH TRU to WRAP

TSD Title: 172 – Waste Receiving and Processing Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A.

Facility: 2336-W Waste Receiving and Processing Facility (WRAP).

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC.
2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|---|

Need Title: Non-Destructive Assay (NDA) of Burial Boxes Containing CH TRUW.

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Certify that the Boxed Waste Assay System (BWAS) NDA technology will meet CH TRUW Waste Isolation Pilot Plant (WIPP) requirements.

Schedule Requirements:

Earliest Date Required: 2004

Latest Date Required: 2006

The inventory quantities of boxed TRU waste will present opportunities for assay for WIPP shipment in this time frame (Currently not enough to make assay worthwhile).

Problem Description: Boxed CH-TRUW must be assayed in a certified NDA system before transporting to WIPP. The BWAS NDA equipment cannot be fully deployed without completing the certification process for WIPP shipments.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

Potential life cycle savings are estimated to \$10,000K.

Benefit to the Project Baseline of Filling Need: Allow cost-effective certification of boxed waste for shipment to WIPP.

Relevant PBS Milestone: N/A

Functional Performance Requirements: The CH-TRUW NDA capability must be able to assay TRU elements and related isotopes inside burial boxes. Specific nuclides are: Pu-238, Pu-239, Pu-240, Am-241, Cs-137, Sr-90, U-233, Pu-242, U-238, and U-234.

Work Breakdown Structure (WBS) No.: 1.02.02.04

TIP No.: N/A.

Justification For Need:

Technical: Presently no NDA technology has been certified for burial boxes.

Regulatory: Must meet Transportation requirements.

Environmental Safety & Health: There are no occupational health concerns associated with processing CH waste using the box waste assay system (BWAS).

Cultural/Stakeholder Concerns: Increase the cost effectiveness of the cleanup. Meet milestones.

Other: None identified.

Current Baseline Technology: No certified technology currently exists for this need.

End-User: Waste Management Programs.

Contractor Facility/Project Manager: Robert Bloom, Fluor Hanford, Inc. (FH), (509) 373-2382, Fax (509) 372-1162, Robert_R_Bloom@rl.gov.

Site Technical Point-of-Contact: John Weidert, FH, (509) 376-8132, Fax (509) 373-3891, John_R_Weidert@rl.gov

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

	Boxed CH TRUW
Waste volume, m ³	Existing: 7,099 m ³ Projected: TBD Total: 7,099 m ³
Waste form	Solid components in burial boxes
Waste stream I.D.	2121
Contaminants and co-contaminants	Specific nuclides of interest are: Pu-238, Pu-239, Pu-240, Am-241, Cs-137, Sr-90, U-233, Pu-242, U-238, and U-234.
Function of technology	Assay boxed CH TRUW to meet WIPP requirements
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

GETTER FOR HYDROGEN

Identification No.: RL-MW026

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1575 – M-91 Product Available to WIPP-CH, 1578 – WRAP Product Available to WIPP

TSD Title: TBD

Operable Unit (if applicable): N/A.

Waste Management Unit (if applicable): N/A.

Facility: 2336 Waste Receiving and Processing Facility (WRAP).

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

X	1. Critical to the success of the ACPC. 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Getter for Hydrogen.

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Adsorption/absorption of hydrogen in air inside drums and boxes containing TRU and other nuclear materials is required to ensure that explosive limits are not reached nor approached inside these containers.

Schedule Requirements:

Earliest Date Required: 2002

Latest Date Required: 2030

Technology needs to be deployed to support the shipment of CH-TRU waste to WIPP and would be useful anytime available when waste is being shipped to WIPP. This technology would alleviate the need for repackaging or other processing of waste with hydrogen concentrations exceeding transportation and shipping criteria.

Problem Description: Technology is needed to mitigate the production of hydrogen gas generation in packages used to ship the Hanford Site waste. The gettering material will have applications in the shipment of CH-TRU waste to WIPP and the shipment of nuclear materials to the SRS (if shipped).

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation:

Zero cost saving is projected.

Benefit to the Project Baseline of Filling Need:

Reduced risk for shipment.

Relevant PBS Milestone: N/A

Functional Performance Requirements: The hydrogen getter must be highly efficient and must maintain its gettering efficiency over a wide range of temperatures, pressures, and humidity levels, and in a variety of transportation environments. Getter performance must not be impaired by the presence of volatile organic carbon (VOC) and must maintain its affinity to hydrogen over the range of use conditions.

Work Breakdown Structure (WBS) No.: 1.02.02.04

TIP No.: N/A.

Justification For Need:

Technical: A gettering material that functions well in broad transportation environments is not available.

Regulatory: Shipment of materials from the Hanford Site to offsite destinations: NUREG-1609, *Standard Review Plan for Transportation Packages for Radioactive Material (DRAFT)*, (NRC 1997) requires that a package demonstrate that hydrogen and other flammable gases make up less than 5% by volume of the total gas inventory within any confined volume.

Shipment of materials on the Hanford Site: *Implementation Guide for Use with DOE O 460.1A Packaging and Transportation Safety*, requires transportation safety documents to follow the guidance of U.S. Nuclear Regulatory Commission (NRC) regulatory guides.

Environmental Safety & Health: There are safety concerns associated with shipping flammable quantities of gas mixtures and radioactive materials.

Cultural/Stakeholder Concerns: Facilitate shipment of CH TRUW to WIPP and closure of the Plutonium Finishing Plant (PFP).

Other: None identified.

Current Baseline Technology: Hydrogen gas getters have been studied at the Los Alamos National Laboratory (LANL) as part of the TRUPACT-II Payload Expansion Plan, but have been shown to be poisoned by VOCs and carbon monoxide. It is important that the getter is not adversely affected by poisons and will respond favorably to other transportation environments as well.

End-User: Waste Management Programs, Nuclear Material Stabilization

Contractor Facility/Project Manager: Robert Bloom, Fluor Hanford, Inc. (FH), (509) 373-2382, Fax (509) 372-1162, Robert_R_Bloom@rl.gov.

Site Technical Point-of-Contact: Kathy Leonard, Duratek Federal Services Northwest, (509) 373-0373, Fax (509) 373-9101, Kathleen_M_Leonard@rl.gov

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

	TRUW for WIPP
Waste volume, m ³ (Figures represent the total waste volume to be shipped to WIPP, only a portion of which, TBD, will require hydrogen gettering)	Existing: 12,100 m ³ Projected: 6,600 m ³ Total: 18,700 m ³
Waste form	Solid components in various containers
Waste stream I.D.	1575, 1578
Contaminants and co-contaminants	Alpha, beta and gamma radiation
Function of technology	Reduce risk of TRUW container explosion by gettering hydrogen
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CHEMICAL ANALYSIS TO MEET WIPP RH-TRU WASTE ACCEPTANCE REQUIREMENTS

Identification No.: RL-MW027

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: M91G

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: WRAP/M-91 Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Chemical Analysis to Meet WIPP Waste Acceptance Requirements (WAC)

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Methods to identify wastes remotely for characteristic of ignitability, reactivity, or corrosivity, and possibly other chemical analysis requirements of the WIPP WAC (not yet issued).

Schedule Requirements:

Earliest Date Required: (10/01/06)

Latest Date Required: 2013

Problem Description: Currently, the CH-WAC contains prohibitions on wastes that are incompatible or exhibit the characteristic of ignitability, reactivity, or corrosivity. It is expected that the RH-WAC will contain the same requirements when it is issued, and possibly requirements for additional chemical analysis. The operation of sorting and characterizing each waste package will be a time consuming operation that must be done remotely for operator safety. Locating and identifying these prohibited wastes is a significant part of that process, especially for the buried wastes where sketchy or no process records exists. Methods to identify these wastes quickly without isolating them and performing remote chemical analysis would have a significant impact on throughput. Conversely, methods to that would quickly confirm the absence of any of these prohibited wastes would be of equal or greater value. The 2013 date is when the M-91 facility is scheduled to be on line for processing RH-TRU waste.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: At this point in project definition, formal estimation of cost savings has not been made, but savings in operations costs could be significant and could potentially approach \$5,000K.

Benefit to the Project Baseline of Filling Need: Reduction in operations costs and potentially a reduction of space/facilities that would be required to achieve the sorting and analysis throughput requirements

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Facilities/Initiate Treatment of RH/CH-LLW

Functional Performance Requirements: Currently, the CH-WAC contains prohibitions on wastes that are incompatible or exhibit the characteristic of ignitability, reactivity, or corrosivity and it is expected that the RH-WAC will contain similar requirements, and possibly requirements for RCRA-compliant chemical characterization. Methods to identify these wastes remotely with a minimum of operator actions would be a significant aid in increasing throughput.

Work Breakdown Structure (WBS) No.: 1.02.02.04

TIP No.: TBD

Justification For Need:

Technical: Currently, the CH-WAC contains prohibitions on wastes that are incompatible or exhibit the characteristic of ignitability, reactivity, or corrosivity (in which case treatment, i.e., stabilization or removal of the item, would be required) and it is expected that the RH-WAC will contain similar requirements, and possibly requirements for RCRA-compliant chemical characterization. Methods to identify these wastes remotely with a minimum of operator actions would be a significant aid in increasing throughput.

Regulatory: Expected WIPP WAC requirements, see above.

Environmental Safety & Health: A reduction of operational steps is possible if technology can be developed and this would translate into less potential for operator exposure (ALARA).

Cultural/Stakeholder Concerns: Allows shipment of waste offsite instead of storage onsite.

Other: None identified.

Current Baseline Technology: N/A

End-User: Waste Management

Contractor Facility/Project Manager: Paul Crane, Fluor Hanford, Inc. (FH), (509) 372-3477, Fax (509) 373-1091, Paul_J_Crane@rl.gov.

Site Technical Point-of-Contact: Paul Crane, FH, (509) 372-3477, Fax (509) 373-1091, Paul_J_Crane@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-DESTRUCTIVE ASSAY OF LARGE BURIED CONTAINERS

Identification No.: RL-MW029

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: M91G

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: M-91 Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

☐
☒
☐ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|---|--|

Need Title: Non-Destructive Assay (NDA) of Large Buried Containers

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Develop the ability to assay large, up to 20 ft in length, suspect TRU containers before retrieval to determine if their Pu content is low enough to reclassify them as Low Level Waste (LLW). Doing so would be a significant cost savings over processing them first and then declaring them LLW.

For any decisions relative to leaving waste in place, the inventory of TRU will be a significant driver in the decision process and will be required for a defensible position. Because this waste was generated and placed in the burial grounds 15 to 30 years ago, significant uncertainties exist relative to actual Pu content. The definition used for TRU before 1982 was 10 nCi/g, and currently it is 100 nCi/g. Therefore, many packages may be listed as TRU when in fact they contain less than the current limit. Because the older records/assay methods would most likely be considered suspect in today’s regulatory environment, actual assay using current technology would be a significant factor in justifying leaving in place as LLW.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: Because these large containers were generated and placed in the burial grounds 15 to 30 years ago, significant uncertainties exist relative to actual Pu content. The definition used for TRU before 1982 was 10 nCi/g, and currently it is 100 nCi/g. Therefore, many packages may be listed as TRU when in fact they contain less than the current limit. Because the older records/assay methods would most likely be considered suspect in today's regulatory environment, actual assay using current technology would be a significant factor in justifying leaving in place as LLW. Also, if it is desired to develop a case for leaving a known waste package in place for ALARA reasons (failing container, too big, etc.), it is anticipated that the old records would also not be sufficient to support a favorable final decision from the regulators. Assay would again be a significant factor in building the case to leave in place. In addition, any waste that can be left in place will result in a reduction of waste to be processed and therefore represent an operational cost savings. Lastly, to support the burial ground performance assessment (PA), the total quantity of TRU left would be required, and NDA using current technology is expected to be required to adequately define that quantity.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: At this point in project definition, formal estimation of cost savings has not been made, but any reduction in processing is expected to save a significant amount of operational costs up to \$5,000K.

Benefit to the Project Baseline of Filling Need: Reduction in operational costs and overall dose to workers (ALARA). In addition, the potential exists to reduce the overall size of the processing facility if a method existed to reclassify a significant amount of this waste.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: Provide a method of non-destructive assay that can confirm the Pu content of buried large containers.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: For any decisions relative to leaving waste in place, the inventory of TRU will be a significant driver in the decision process and will be required for a defensible position. Because this waste was generated and placed in the burial grounds 15 to 30 years ago, significant uncertainties exist relative to actual Pu content. The definition used for TRU before 1982 was 10 nCi/g, and currently it is 100 nCi/g. Therefore, many packages may be listed as TRU when in fact they contain less than the current limit. Because the older records/assay methods would most likely be considered suspect in today's regulatory environment, actual assay using current technology would be a significant factor in justifying leaving in place as LLW.

Regulatory: The definition used for TRU before 1982 was 10 nCi/g, and currently it is 100 nCi/g. Therefore, many packages may be listed as TRU when in fact they contain less than the current limit. Because the older records/assay methods would most likely be considered suspect in today's regulatory environment, actual assay using current technology would be a significant factor in justifying leaving in place as LLW.

Environmental Safety & Health: Any reduction in processing will result in less risk of exposure and a reduction of dose to operators (ALARA).

Cultural/Stakeholder Concerns:

Other: None identified.

Current Baseline Technology: N/A

End-User: Waste Management

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PLUTONIUM CONTAMINATION CONTROL LARGE CONTAINER LOAD-IN/LOAD-OUT SYSTEMS

Identification No.: RL-MW030

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: M91G

TSD Title: TBD

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 facility

Priority Rating: This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Plutonium Contamination Control - Large Container Load-in/Load-out Systems

Need/Opportunity Category: *Technology Need* -- There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: Provide bagless transfer ports that allow of the entry of various size large containers into a plutonium cell bagless load-out ports that utilize a SWB as the final waste package.

The M-91 facilities that will be repackaging both CH and RH TRU wastes will require very stringent controls to avoid the spread of plutonium contamination. This will be especially critical in the open, sort, size reduction and repackaging portion of the project. This portion of the facility will most likely be a cell or series of interconnected cells to contain the plutonium contamination and waste container entry into the cell and load-out of processed waste present a significant challenge. Historically, these entry/exit ports have used bag-in/bag-out concepts or, in the case of 55 and 83-gallon drums special bagless transfer system. This bagless feature provides for contamination control and allows greater productivity and less waste generated.

For the large containers that exist as buried waste, no bagless entry systems are known to exist that will permit relatively easy contamination free entry into the process cell. For CH wastes, the final waste package is expected to be a standard waste box (SWB) and for reasons of productivity it will be especially important to have some form of bagless transfer system to permit quick/simple waste load out.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: Some of the waste packages identified for processing contain large quantities of Pu, and much of this material will be dispersible. Single containers hold more than 400 g. The Pu oxide in these wastes represents an extreme contamination control challenge for both CH and RH waste processing. Control standards for airborne Pu are far more stringent than for beta and gamma contamination because the physical and electrostatic characteristics of Pu oxide result in a material that is easily dispersed. In addition, decontamination of facilities and equipment is much more difficult for Pu contamination than for fission products. Because of these characteristics, a specific technology and practice have been developed for contamination control during the handling and processing of Pu-contaminated materials

Some form of a positive seal at the transfer point is required and the design must be such that no plutonium leaves the cell during the entry or exit process. Currently, technology exists for transfers of 55 and 83 gallon drums into and out of processing cells, but for large container entry and SWB load-out, technology has not been developed.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The need for this type of transfer system is based upon operator safety, avoidance of plutonium contamination, and productivity. At this point in project definition, no cost savings are projected.

Benefit to the Project Baseline of Filling Need: The need to provide for plutonium contamination control is essential to successful operation of the M-91 facilities. The use of bagless transfer systems will greatly improve operating efficiency and reduce the potential for the spread of plutonium and the resulting impacts to workers.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements: Provide bagless transfer ports that allow of the entry of various size large containers into a plutonium cell bagless load-out ports that utilize a SWB as the final waste package. Both ports must not allow any loose plutonium to pass from the inside of the cell to the outside.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: N/A

Justification For Need:

Technical: Controlling the spread of plutonium from working areas, or cells, where loose plutonium is present is very difficult and cannot reliably be done by just using air flow. Some form of a positive seal at the transfer point is required and the design must be such that no plutonium leaves the cell during the entry or exit process. Currently, technology exists for transfers of 55 and 83 gallon drums into and out of processing cells, but for large container entry and SWB load-out, technology has not been developed.

Regulatory: Supports the milestone M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW.

Environmental Safety & Health: The control of plutonium is essential to meeting radiation worker safety.

Cultural/Stakeholder Concerns:

Other: None identified.

Current Baseline Technology: N/A

End-User: Waste Management

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-LENGTH CONTAMINATED EQUIPMENT DISPOSAL

Identification No.: RL-MW031

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3467 – LDR Compliant Solids from Storage to Disposal

TSD Title: 183 – MLLW-RMW Trenches

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Low-Level Burial Grounds

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Long-Length Contaminated Equipment Disposal

Need/Opportunity Category: *Technology Need* --There is no existing or currently identified technology capable of solving the site’s problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: For long-length contaminated equipment (LLCE) there is a need to accommodate LLCE space needs for offloading the waste. Depending on size and amount of waste already in the trench, in some cases it will be physically impossible to haul LLCE down into the trench and have cranes and other equipment staged for offloading. Alternatives could include a crane large enough to offload from the top of the trench. However, there is an issue of the ability of the LLCE placed in Poly containers to withstand the overburden after they are buried. It is unknown whether putting a large crane with outriggers on top of where these are buried would damage previously buried waste. Size reduction of the LLCE before packaging or repackaging is another alternative that could be explored. Efficiency in use of trench space with LLCE is another need that needs to be studied.

Schedule Requirements:

Earliest Date Required: 9/30/02

Latest Date Required: 9/30/04

Problem Description: A method to bring LLCE into the current mixed waste trenches (218W5 T31/34) that is not limited by size or weight restrictions.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: The need for a method, not restricted by size or weight, to bring LLCE into the mixed waste trenches is based on

operational efficiency and lack of proper storage space within the Waste Management Project. Any estimate of cost savings to WMP would rely on whether WMP could choose when to accept the LLCE.

Benefit to the Project Baseline of Filling Need: Avoidance of cost and manpower needs to store LLCE while awaiting an open window when existing equipment might be used to bring the LLCE into the mixed waste trench.

Relevant PBS Milestone: None

Functional Performance Requirements: Provide a method to bring LLCE into the mixed waste trench during any phase of trench loading.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: Current equipment only allows LLCE to be brought into the mixed waste trench during certain loading phases due to size and weight restrictions. The LLCE may have to be stored for long periods of time before a window of opportunity arrives.

Regulatory: RCRA and DOE 435.1 storage requirements.

Environmental Safety & Health: If LLCE has to be stored; this will increase handling and lifting operations and contribute to the risk of a handling accident. Storage requirements, whether at WMP or the Generator, brings up ALARA issues for those personnel required for surveillance.

Cultural/Stakeholder Concerns: None identified.

Other: None identified.

Current Baseline Technology: Only limited amounts of LLCE are placed in the trenches during limited time periods.

End-User: Waste Management.

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	Current: N/A; Forecasted (5 yrs): TBD m ³
Waste form	Long-length contaminated equipment
Waste stream I.D.	3467
Contaminants and co-contaminants	Contaminated with tank waste
Function of technology	Allow LLCE to be disposed of in trenches
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CATEGORY 3 MLLW DISPOSAL

Identification No.: RL-MW032

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 3467 – LDR Compliant Solids from Storage to Disposal, 3468 – LDR Compliant Solids to Disposal

TSD Title: 183 – MLLW-RMW Trenches

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Low-Level Burial Grounds

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- ☐ 1. Critical to the success of the ACPC
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Category 3 MLLW Disposal

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: There could be cost advantages to developing a lighter and more space efficient Category 3 equivalent packaging (vs. concrete or grout) for disposal of this mixed waste. In many cases, because waste is frequently uranium, grout is required for leachability reasons. For others, where grout is not so important, other incompressible packages are currently accepted as equivalent. Mixed waste trench space is very costly, so development of a more space-efficient technology could create a less expensive disposal alternative. Lighter weight alternative packaging would have advantages in offloading the waste into the trench due to lighter equipment and fewer concerns about the weight of large disposal equipment on top of already-disposed and buried waste.

Schedule Requirements:

Earliest Date Required: 6/30/02

Latest Date Required: 6/30/03

Problem Description: A more space-efficient technology is desired. Lighter packages will also mitigate the potential for future subsidence and breaching of underlying containers of already-disposed waste.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD

Benefit to the Project Baseline of Filling Need: Cost savings due to more efficient trench use and savings from using lighter equipment for off-loading waste.

Relevant PBS Milestone: N/A

Functional Performance Requirements:

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: More efficient use of trench space

Regulatory: N/A

Environmental Safety & Health: Minimizes container breaching of underlying waste and the resultant potential exposure to the worker and accessible environment.

Cultural/Stakeholder Concerns: N/A

Other: None identified.

Current Baseline Technology: Disposal using concrete or grout

End-User: Waste Management.

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	Current: TBD; Forecasted (5 yrs): 2,452 m ³
Waste form	Grouted, solid waste
Waste stream I.D.	3467, 3468
Contaminants and co-contaminants	TBD
Function of technology	Develop a more space-efficient disposal technology and resolve waste handling problems.
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PROCESSING WASTE FOR SHIPMENT TO WIPP

Identification No.: RL-MW033

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1578 – WRAP Product Available to WIPP

TSD Title: 205 – WRAP

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: WRAP

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Processing Waste for Shipment to WIPP

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: Technology needs include:

- The need for a method to increase production rates of CH-TRU processing for shipment to WIPP, including improved glovebox tools and procedures.
- Better containment of contamination (on the inlet and loadout ports),
- Technology to breach inner confinement (plastic bags) without sorting and manually piercing
- Improved headspace gas sampling and analysis capability (faster and cheaper).

Schedule Requirements:

Earliest Date Required: 10/01/04

Latest Date Required: 10/01/04

Problem Description: Technology is needed to improve CH-TRU processing in the areas of contamination control, improved tools and procedures, inner confinement breaching, and improved headspace gas sampling.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD

Benefit to the Project Baseline of Filling Need: Lower cost of processing CH-TRU and improved safety through contamination control.

Relevant PBS Milestone: None

Functional Performance Requirements:

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: Controlling spread of contamination and improved processing rates through various methods.

Regulatory: None identified

Environmental Safety & Health: Control of contamination is essential for worker safety.

Cultural/Stakeholder Concerns: None identified

Other: None identified.

Current Baseline Technology: Waste is currently being processed in the WRAP TRU glovebox line. Technology would improve efficiency of the process.

End-User: Waste Management.

Contractor Facility/Project Manager: Robert Bloom, Fluor Hanford, Inc. (FH), (509) 373-2382, Fax (509) 372-1162, Robert_R_Bloom@rl.gov.

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	Current: N/A; Forecasted (5 yrs): 1,600 m ³
Waste form	Debris waste
Waste stream I.D.	1578
Contaminants and co-contaminants	TBD
Function of technology	Increase efficiency of CH-TRU waste processing
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DRUM VENTING

Identification No.: RL-MW034

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1561 – CH TRU Suspect Drums

TSD Title: NA

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: NA

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Drum Venting

Need/Opportunity Category: *Technology Need* --There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: There is a technology need for field venting of potentially pressurized drums. As retrieval of stored drums gets underway next FY, there will be a need to safely handle drums that were stored without vents installed. An existing technology used at other sites requires transport of the suspect drums to a bomb-proof enclosure for breaching. This approach is extremely expensive, both in hardware (about \$2M), and inefficient operations (about 4 hours per drum to vent and return). An unsolicited concept has been offered by Vista Engineering that shows promise of a much simpler and cheaper system. The concept will be further developed to solicit support from EM technology programs.

Schedule Requirements:

Earliest Date Required: 1/31/02

Latest Date Required: 9/30/02

January 31, 2002 is the date for starting readiness activities for TRU retrieval. September 30, 2002 is when retrieval is expected to be underway.

Problem Description: Drums without vents could over-pressurize and cause loss of contamination control and injury, so a method of venting is required in order to retrieve the drums. The existing technology used elsewhere is both expensive and inefficient.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: N/A

Benefit to the Project Baseline of Filling Need: Will allow drum retrieval, on schedule.

Relevant PBS Milestone: N/A

Functional Performance Requirements:

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: Venting is required to prevent over-pressurization

Regulatory: N/A

Environmental Safety & Health: Potential issues with contamination control and injury if drums are not vented.

Cultural/Stakeholder Concerns: TBD

Other: None identified.

Current Baseline Technology:

End-User: Waste Management.

Contractor Facility/Project Manager: Doug Greenwell, Fluor Hanford, Inc. (FH), (509) 372-1123, Fax (509) 373-1091, Doug_Greenwell@rl.gov

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, Dale_G_Black@rl.gov.

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, Kevin_D_Leary@rl.gov.

Waste volume, m ³	Current: N/A; Forecasted (5 yrs): 2,160 m ³
Waste form	Drummed waste
Waste stream I.D.	1561
Contaminants and co-contaminants	TBD
Function of technology	Create a simpler and cheaper method for venting drums
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

APPLICATION OF SUPERCOMPACTION TO CH-TRU WASTE

Identification No.: RL-MW035

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 2121 – CH TRU to WRAP

TSD Title: 205 – WRAP

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: WRAP

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

X	1. Critical to the success of the ACPC 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays) 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Application of Supercompaction to CH-TRU Waste

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: As designed, the Waste Receiving and Processing Facility has a glovebox for TRU waste and a glovebox for LLW waste. Current needs are for significantly more TRU capacity than LLW capacity. Therefore, there would be a large benefit to converting the LLW glovebox to also accept TRU waste processing. This will result in a balanced process flow for WRAP without choke points. It will also allow for supercompaction capability for TRU waste processing, which is not currently available. Supercompaction of these wastes will increase volumetric efficiency of shipments to the Waste Isolation Pilot Plant.

Schedule Requirements:

Earliest Date Required: 1/01/03

Latest Date Required: 1/01/03

Needed by 1/01/03 due to expected increased TRU processing needs at WRAP.

Problem Description: Processing rate of TRU waste through the Waste Receiving and Processing facility is constrained due to having only a single glovebox line capable of processing the waste. If the LLW line could be converted to also accept TRU waste, this constraint would be eliminated.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: Approximately \$95,000K could be saved over 20 years through implementation of this project. The majority of the savings would be for reduced headspace gas sampling requirements due to the ability to compact the TRU

waste in the former LLW-only line. (An average 4 to 1 compaction ratio is expected, which yields a 75% reduction in sampling needs, at \$3K per sample). There would also be savings in transportation to WIPP, also due to compaction, and labor savings.

Benefit to the Project Baseline of Filling Need: Cost savings and ability to meet required processing schedules.

Relevant PBS Milestone: Outyear production milestones for the TRU Program.

Functional Performance Requirements:

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: NA

Justification For Need:

Technical: Improved efficiency of TRU waste processing through use of supercompaction

Regulatory: NA

Environmental Safety & Health: New exit port will provide increased contamination control.

Cultural/Stakeholder Concerns: NA

Other: None identified.

Current Baseline Technology: Existing TRU line does not have compaction ability. Installation of a tipper and modifying the exit port to a TRU port in the LLW line will allow compaction of TRU waste in the former LLW-only line.

End-User: Waste Management.

Contractor Facility/Project Manager: Robert Bloom, Fluor Hanford, Inc. (FH), (509) 373-2382, Fax (509) 372-1162, [Robert R Bloom@rl.gov](mailto:Robert_R_Bloom@rl.gov).

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	Current: N/A; Forecasted (5 yrs): 1,600 m ³
Waste form	Drummed TRU waste
Waste stream I.D.	2121
Contaminants and co-contaminants	TBD
Function of technology	Allow supercompaction to be used with TRU waste.
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF RH TRU SLUDGES SUCH AS WASTE COMING OUT OF K BASINS STORAGE POOLS

Identification No.: RL-MW036

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1566 – RH TRU Stored/New

TSD Title: 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

<u> X </u>

_____ | 1. Critical to the success of the ACPC
2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success. |
|--------------------------------|--|

Need Title: Treatment of RH TRU Sludges such as Waste Coming out of K Basins Storage Pools.

Need/Opportunity Category: *Technology Need* --There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: M-91 facilities will need to have the capability to treat RH-TRU waste in sludge form that may be contaminated with PCBs. K Basins sludge will be stored in T Plant starting Jan 2003 and is being designed with a maximum 30-year storage life. Another waste that may use this technology is sludge in T Plant canyon tanks. Current estimates are that 2,250 cubic meters of RH-TRU waste will need to be treated by the year 2040, with most prior to 2020. T Plant is considered the main candidate for processing this waste.

Schedule Requirements:

Earliest Date Required: 2007

Latest Date Required: 2013

Technology needs to be established between end of FY 2007 (conceptual design start) and 2013 (start of operations), to support the M-91 facility baseline.

Problem Description: With large-scale quantities of RH-TRU waste, there is no current method of treatment, and treatment is required.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: No alternative to treatment is available, so cost savings are N/A.

Benefit to the Project Baseline of Filling Need: Allows fulfillment of legal obligation to treat waste.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements:

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: No current method of treating large quantities of this waste is available.

Regulatory: Tri-Party Agreement milestone M-91-15 requires treatment (see above). State regulations require LDR treatment of waste.

Environmental Safety & Health: Reduces environmental hazards associated with long-term storage of this waste.

Cultural/Stakeholder Concerns: Helps eliminate concerns that Hanford Site waste is being left onsite untreated.

Other: None identified.

Current Baseline Technology: N/A

End-User: Waste Management.

Contractor Facility/Project Manager: Bob Barnettlor, Fluor Hanford, Inc. (FH), (509) 373-9501, Fax (509) 373-1539, [R B Bob Barnettlor@rl.gov](mailto:R_B_Bob_Barnettlor@rl.gov)

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	Current: 0 m ³ ; Forecasted (5 yrs): 46 m ³
Waste form	RH-TRU sludge
Waste stream I.D.	1566
Contaminants and co-contaminants	References: SNF-7767, "Supporting Basis for Spent Nuclear Fuel Project Sludge Technical Databook", Aug. 2001; HNF-SD-SNF-TI-009, "105K Basin Material Design Basis Feed Description for SNF Project Facilities, Vol. 2, Sludge", April 2001; HNF-SD-SNF-TI-015, "Spent Nuclear Fuel Project Technical Databook", Volumes 1 and 2, September 2001.
Function of technology	Capability for treatment of RH-TRU sludges
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-DESTRUCTIVE EVALUATION OF RH WASTE

Identification No.: RL-MW037

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: 1566 – RH TRU Stored/New

TSD Title: 206 – M-91 Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Future M-91 Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

☒	1. Critical to the success of the ACPC
☐	2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
☐	3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Non-destructive Evaluation of RH Waste

Need/Opportunity Category: *Technology Opportunity* – The Site desires an alternative to the current baseline technology.

Need Description: The M-91 facilities that will be repackaging both CH and RH TRU wastes will require containers to be examined using radiographic techniques. RH waste usually contains dense shielding material to meet ALARA requirements for storage. The shielding cannot be penetrated with conventional X-Ray equipment. Develop NDE technology to examine RH TRUW where shielding is internal to packaging that will meet WIPP requirements.

Schedule Requirements:

Earliest Date Required: 2004

Latest Date Required: 2013

Technology needs to be established by the end of fiscal year 2013. This is when the M-91 facility is scheduled to begin processing RH-TRU waste.

Problem Description: It is anticipated that the RH WIPP Waste Acceptance Criteria (WAC), when issued, will require NDE of the waste. This technology is not currently available. Visual inspection is the alternative.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD (visual inspection rather than NDE)

Benefit to the Project Baseline of Filling Need: Reduction of exposure, higher processing rates.

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Acquisition of Facilities and Initiate Treatment of RH and Large Container (CH) LLMW

Functional Performance Requirements:

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: No technology for NDE currently exists.

Regulatory: Future issuance if RH WIPP WAC

Environmental Safety & Health: If packages can be x-rayed rather than repackaged, it would reduce personnel exposure.

Cultural/Stakeholder Concerns: N/A

Other: None identified.

Current Baseline Technology: Visual inspection

End-User: Waste Management.

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, m ³	Current: 302 m ³ ; Forecasted (total long-term): 879 m ³
Waste form	RH TRU solid waste
Waste stream I.D.	1566
Contaminants and co-contaminants	TBD
Function of technology	Provide NDE technology for RH TRU with internal shielding
Source category	Various Hanford Site programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IODINE-129 CHARACTERISTICS

Identification No.: RL-MW038

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-CP02

Waste Stream: NA

TSD Title: 1775 – 200 Area Effluent Treatment Facility

Operable Unit (if applicable): N/A

Waste Management Unit (if applicable): N/A

Facility: Effluent Treatment Facility

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” Priority:

- X 1. Critical to the success of the ACPC
- 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
- 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Iodine-129 Characteristics

Need/Opportunity Category: *Technology Need* --There is no existing or currently identified technology capable of solving the site's problem (i.e., technology gap exists, no baseline approach has been identified).

Need Description: It is anticipated that in the future, the ETF may receive wastewaters that contains high levels of I-129, which is highly soluble in high pH solutions. When the wastewater is acidified, this I-129 may be emitted out the stack. The characteristics of I-129 at different operating conditions may be needed to determine treatability at the ETF.

Schedule Requirements:

Earliest Date Required: 2003

Latest Date Required: June 2005

Must be implemented by June 2005, consistent with the arrival of the Waste Treatment Plant effluent.

Problem Description: The projected level of I-129 in the effluent to be received from WTP is outside the ETF treatability envelope.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: TBD

Benefit to the Project Baseline of Filling Need: Treat WTP effluent with elevated level of I-129.

Relevant PBS Milestone: N/A

Functional Performance Requirements: A method for treatment of elevated level of I-129 in WTP effluent.

Work Breakdown Structure (WBS) No.: 1.2.2

TIP No.: Candidate

Justification For Need:

Technical: I-129 chemistry unknown

Regulatory: Wastewater may contain elevated levels I-129 that may exceed NOC air emission levels.

Environmental Safety & Health: N/A

Cultural/Stakeholder Concerns: N/A

Other: None identified.

Current Baseline Technology: None

End-User: Waste Management.

Contractor Facility/Project Manager: TBD

Site Technical Point-of-Contact: Dale Black, Fluor Hanford, Inc. (FH), (509) 376-8458, Fax (509) 372-1441, [Dale G Black@rl.gov](mailto:Dale_G_Black@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

Waste volume, liters	Current: N/A; Forecasted (5 yrs): 1.73 billion liters
Waste form	Liquid, ETF Feed
Waste stream I.D.	NA
Contaminants and co-contaminants	TBD
Function of technology	Determine I-129 treatability at ETF
Source category	Various Hanford Site programs

SCIENCE NEEDS/OPPORTUNITIES STATEMENT

NON-INTRUSIVE, NON-DESTRUCTIVE CHARACTERIZATION METHODS FOR HAZARDOUS CHEMICAL COMPONENTS OF MIXED LOW-LEVEL WASTE

Identification No.: RL-MW07-S

Date: October 2001

Program: Waste Management

OPS Office/Site: Richland Operations Office/Hanford Site

PBS No.: RL-WM06

Waste Stream: 1469 – MLLW Debris to WM

TSD Title: TBD

Operable Unit (if applicable): N/A.

Waste Management Unit (if applicable): N/A.

Facility: CWC, WRAP, Future M-91 Facility.

Priority Rating: This entry addresses the “Accelerated Cleanup: Paths to Closure (ACPC)” priority:

- ☐ 1. Critical to the success of the ACPC.
- ☐ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
- ☒ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success.

Need Title: Non-Intrusive, Non-Destructive Characterization Methods for Hazardous Chemical Components of Mixed Low-Level Waste.

Need/Opportunity Category: Science Need

Need Description: Development of non-intrusive, non-destructive methods to identify and measure non-radionuclide, RCRA hazardous components of mixed low-level. Non-destructive, non-intrusive methods exist for measuring radionuclide components, but currently no known technique exists for detection and quantification of non-radionuclide, hazardous components within a waste drum. There is a special need for the measurement of volatile and semi-volatile organic compounds and for measuring PCBs in solid materials at RCRA hazard levels. Contaminates that are of primary interest include: acetonitrile, acrolein, aluminum, barium, cadmium, calcium oxide, carbon disulfide, chlorine gas, chloroform, chromium III, copper ion, cyanide ion, dichloromethane, fluorine (gas), fluoride ion, hydrogen chloride, hydrogen fluoride, kerosene, lead, mercury, nickel, nitric acid, nitrobenzene, polystyrene, potassium hydroxide, pyridine, silver chloride, sodium cyanide, sodium, hydroxide, toluene, tributyl phosphate, and triethylamine.

Schedule Requirements:

Earliest Date Required: (12/31/02)

Latest Date Required: (N/A)

Technology if available could be deployed anytime after calendar year 2000.

Problem Description: Much of the Hanford Site's MLLW will be treated by offsite commercial vendors. There is a high cost associated with the present baseline of opening drums for sampling and characterizing the waste prior to treatment.

Potential Life-Cycle Cost Savings of Need (in \$000s) and Cost Savings Explanation: At this point in project definition, formal estimation of cost savings has not been made, but savings in operations costs could be significant and could potentially approach \$5,000K.

Benefit to the Project Baseline of Filling Need: Reduction in operations costs and potentially a reduction of space/facilities that would be required to achieve the sorting and analysis throughput requirements

Relevant PBS Milestone: A2G-08-109 M-91-15 Complete Facilities/Initiate Treatment of RH/CH-LLW

Functional Performance Requirements: Cost-effective characterization/verification methods for MLLW prior to LDR treatment.

Work Breakdown Structure (WBS) No.: N/A

TIP No.: N/A.

Current Baseline Technology: Baseline technology is intrusive sampling for chemical analysis.

End-User: Waste Management Programs.

Contractor Facility/Project Manager: Robert Bloom, Fluor Hanford, Inc. (FH), (509) 373-2382, Fax (509) 372-1162, [Robert R Bloom@rl.gov](mailto:Robert_R_Bloom@rl.gov).

Site Technical Point-of-Contact: Michael Purcell, FH, (509) 373-3240, Fax (509) 373-1180, [Michael A Purcell@rl.gov](mailto:Michael_A_Purcell@rl.gov).

DOE End-User/Representative Point-of-Contact: Kevin Leary, DOE-RL, (509) 373-7285, Fax (509) 372-1926, [Kevin D Leary@rl.gov](mailto:Kevin_D_Leary@rl.gov).

**CROSSWALK FOR FY 2001/FY 2002
WASTE MANAGEMENT
SCIENCE AND TECHNOLOGY NEEDS**

Old (FY01)	New (FY02)	Need Title	Changes in FY 2002 Revision	FY02 PBS No.
TECHNOLOGY NEEDS				
RL-MW01	RL-MW01	Remote Macroencapsulation of RH MLLW Debris	Updated	RL-CP02
RL-MW02	RL-MW02	Remotely Controlled Size/Volume Reduction Techniques for RH MLLW and RH TRUW	Updated	RL-CP02
RL-MW04	RL-MW04	Remote Decontamination of RH TRUW Debris to Support Reclassification into Non-TRUW Category	Updated	RL-CP02
RL-MW05	RL-MW05	Remote Treatment of RH Soils and Other Solid Wastes Contaminated with Organics	Updated	RL-CP02
RL-MW06	RL-MW06	Treatment of CH TRUW Liquid Wastes Contaminated with PCBs and Ignitables	Updated	RL-CP02
RL-MW013	RL-MW013	Non-Destructive Assay (NDA) of RH TRUW (High Beta/Gamma field) to meet WIPP Requirements	Updated	RL-CP02
RL-MW014	RL-MW014	Technology to Dispose of 12 Drums of Pu238 (500 g/drum)	Updated	RL-CP02
RL-MW016	RL-MW016	System to Retrieve RH TRUW from Caissons	Updated	RL-CP02
RL-MW017	RL-MW017	Treatment of MLLW Batteries	Updated	RL-CP02
RL-MW018	RL-MW018	Treatment of MLLW Mercury Wastes	Updated	RL-CP02
RL-MW020	RL-MW020	Solidification of High Salt Wastes/Secondary Waste Solidification	Updated	RL-CP02
RL-MW021	RL-MW021	Control of Equipment Corrosion Caused by Chloride	Updated	RL-CP02
RL-MW022	RL-MW022	Identification and Control of Biological Foulants	Updated	RL-CP02
RL-MW023	RL-MW023	Tritium Removal from Wastewater	Updated	RL-CP02
RL-MW025	RL-MW025	Non-Destructive Assay (NDA) of CH TRUW to Meet WIPP Requirements for Burial Boxes - Certification of Boxed Waste Assay System (BWAS)	Updated	RL-CP02
RL-MW026	RL-MW026	Getter for Hydrogen	Updated	RL-CP02
RL-MW027	RL-MW027	Chemical Analysis to Meet WIPP RH-TRU Waste Acceptance Requirements	Updated	RL-CP02
RL-MW028		Integrity of Buried Large Containers	Deleted	
RL-MW029	RL-MW029	Non-Destructive Assay of Large Buried Containers	Updated	RL-CP02

Old (FY01)	New (FY02)	Need Title	Changes in FY 2002 Revision	FY02 PBS No.
RL-MW030	RL-MW030	Plutonium Contamination Control Large Container Load-In/Load-Out Systems	Updated	RL-CP02
	RL-MW031	Long-Length Contaminated Equipment Disposal	New	RL-CP02
	RL-MW032	Category 3 MLLW Disposal	New	RL-CP02
	RL-MW033	Processing Waste for Shipment to WIPP	New	RL-CP02
	RL-MW034	Drum Venting	New	RL-CP02
	RL-MW035	Application of Supercompaction to CH-TRU Waste	New	RL-CP02
	RL-MW036	Treatment of RH TRU Sludges Such as Waste Coming out of K Basins Storage Pools	New	RL-CP02
	RL-MW037	Non-Destructive Evaluation of RH Waste	New	RL-CP02
	RL-MW038	Iodine-129 Characteristics	New	RL-CP02
SCIENCE NEEDS				
RL-MW07-S	RL-MW07-S	Non-Intrusive, Non-Destructive Characterization Methods for Hazardous Chemical Components of Mixed Low-Level Waste	Updated	RL-CP02
RL-MW027-S		Technology for the Determination of Organic Constituents in Small Waste Samples	Deleted	
RL-MW028-S		Technology to Determine Radionuclide Speciation in Waste	Deleted	

FY02 TANKS TECHNOLOGY NEEDS

**FY 2002 TANKS
TECHNOLOGY NEEDS INDEX**

ID#	NEED TITLE	PBS No.	WBS No.
SAFE STORAGE			
RL-WT004	Double-Shell Tank (DST) Corrosion Monitoring	ORP-TW03	5.01.03.05
RL-WT021	Cleaning, Decontaminating and Upgrading Hanford Pits	ORP-TW04 ORP-TW03	5.02.01.02.06.04.10 5.01.03.04.02
RL-WT022	Adapting Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the Double-Shell Tanks (DSTs)	ORP-TW03	5.02.02.01.01.23 5.01.03.05
RL-WT067	Improved Double Shell Tank (DST) Integrity Nondestructive Examination (NDE)Measurement Tools	ORP-TW03	5.01.03.05
RL-WT072	Use of Handheld Technology to Automate Operator Data Sheets for Tank Farm Operations: Surveillance Automation for Tank Farms	ORP-TW03	5.01.03..01
RL-WT104	Cleanable HEPA filter	ORP-TW03	5.01.03.02
RL-WT105	Coalescer for Tank Waste in Pits and Airborne Contamination	ORP-TW03 ORP-TW04	5.01.03.04.02
RL-WT106	Double Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools	ORP-TW03	5.01.03.05
RL-WT107	Grab Sampling Dose Reduction	ORP-TW03	5.01.03.06.06.02
RL-WT108	In-tank Camera and Lighting	ORP-TW03 ORP-TW04	5.01.03.04
RL-WT109	Radiation Survey	ORP-TW03	5.01.03.01
RL-WT110	Remote Jumper Gasket Replacement	ORP-TW03	5.01.03.04.02
RL-WT111	Remote Tank Wall Repair	ORP-TW03	5.01.03.05
RL-WT114	Tank Farm Weather Enclosure	ORP-TW04	5.01.02.04 5.01.03.04 5.02.01.01.32 5.02.02.02.0 (W-211) 5.02.02.03.01 (W-314)
RL-WT117	Rapid Polychlorinated Biphenyl (PCB) Measurement System	ORP-TW03	5.01.01.02 5.01.03.06.01.04
RETRIEVAL			
RL-WT005	Remote Inspection of High-Level Waste Single-Shell Tanks (SSTs)	ORP-TW03 ORP-TW04	5.02.01.01.02.02

ID#	NEED TITLE	PBS No.	WBS No.
RL-WT009	Representative Sampling to Support Operations and Disposal	ORP-TW03 ORP-TW04	5.01.03.06.02 5.02.02.01
RL-WT026	Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)	ORP-TW04	5.02.01.01.02.02
RL-WT027	Tank Leak Mitigation Systems	ORP-TW04	5.02.01.01.02.02
RL-WT032	Monitoring of Key Waste Physical Properties During Retrieval and Transport	ORP-TW04	5.02.02.01.02
RL-WT054	Mixer Pump Mobilization Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)	ORP-TW04	5.02.02.01.04
RL-WT060	Hanford/SRS Waste Mixing Mobilization	ORP-TW04	5.02.02.01.04
RL-WT062	Variable Suction Level Transfer Pump	ORP-TW04	5.02.02.01.04
RL-WT063	Hanford SST Saltcake Dissolution Retrieval	ORP-TW04	5.02.01.01.01.01
RL-WT068	Radionuclide Source Term from Tank Residuals	ORP-TW04 ORP-TW11	5.02.01.01.01.01
RL-WT088	Advanced Approaches for Reducing Waste Volume Stored in DSTs	ORP-TW04	5.02.02
RL-WT089	Alternate Retrieval Methods from Potentially Leaking Single-Shell Tanks (SSTs)	ORP-TW04	5.02.01.01.01.01 5.02.01.01.03.02
RL-WT090	Chemical and Physical Behavior of Sludge Wastes	ORP-TW04	5.02.02.01.02.01
RL-WT091	Chemical and Physical Behavior of Saltcake Wastes	ORP-TW04	5.02.02.01.02.01
RL-WT103	Separable Organic Phase Destruction, Removal, and Monitoring In Tank Waste	ORP-TW04	5.01.04.02.04.01.01.01 5.01.04.02.04.04
RL-WT112	Chemical Dissolution of Water Insoluble Wastes from Single-Shell Tanks (SSTs)	ORP-TW04	5.02.01.01.01.01
RL-WT113	Selective Species Removal	ORP-TW04 ORP-TW09	5.02.01.01.01.01
RL-WT115	Technology to Support Post-Retrieval Evaluation of Single Shell Tanks (SSTs) During Retrieval	ORP-TW04 ORP-TW11	5.02.01.01.01.01
RL-WT116	Toxic Gas Control during Waste Retrieval	ORP-TW04	5.02.01.01.01.01
DISPOSAL			
RL-WT015	Standard Method for Determining Waste Form Release Rate	ORP-TW09	5.04.01.03
RL-WT016	Glass Monolith Surface Area	ORP-TW09	5.04.01.03

ID#	NEED TITLE	PBS No.	WBS No.
RL-WT066	Compositional Dependence of the Long-Term Performance of Glass as a Low-Activity Waste Form	ORP-TW09	5.04.01.03
CLOSURE			
RL-WT001	Technetium-99 Analysis in Hanford Tank Waste	ORP-TW04 ORP-TW11	5.02.01.02.07.12 5.05.01.01
RL-WT017	Long-Life Waste Isolation Surface Barrier	ORP-TW11	5.05.01.01
RL-WT061	Reactive Barriers to Contaminant Migration	ORP-TW04 ORP-TW09 ORP-TW11	5.05.01.01 5.04.01 5.02.01.01.02.02
RL-WT069	Value of Information Decision Analysis for Tank Farm Closure	ORP-TW11	5.02.01.01.02.02
RL-WT102	Advanced Characterization Tools for Contaminants of Concern	ORP-TW03 ORP-TW11	5.05.01.01
INITIAL QUANTITY			
RL-WT080	Advanced/Improved Vitrification	ORP-TW06LT	
RL-WT086	Anti-foaming Agents for Evaporation of Alkaline Wastes	ORP-TW06LT	
RL-WT092	Improved Separation Agents and Processes to Remove Cesium from Supernatant Solutions	ORP-TW06LT	
RL-WT093	Filtration Optimization and Process Enhancement	ORP-TW06LT	
RL-WT101	Sulfate Mitigation for Hanford Tank Low Activity Waste (LAW) Vitrification	ORP-TW06LT	
RL-WT118	Process Flowsheet Model	ORP-TW06LT	
RL-WT119	Melter Disassembly/Disposal	ORP-TW06LT	
BALANCE OF MISSION			
RL-WT084	Extension of Glass Properties Model to LAW and Phase II HLW Glass Composition Ranges	ORP-TW07	
RL-WT098	Erosion Testing	ORP-TW07	
RL-WT100	HLW/LAW Melter Operation	ORP-TW07	
RL-WT120	Pretreatment Approaches to Mitigate Sulfate Issues in LAW Immobilization	ORP-TW07	
RL-WT121	Advanced Immobilization for LAW to Reduce	ORP-TW07	

ID#	NEED TITLE	PBS No.	WBS No.
	BOM Cost		
RL-WT122	Fast Analytical Methods for Waste Processing	ORP-TW07	

**FY 2002 TANKS
SCIENCE NEEDS INDEX**

ID#	NEED TITLE	PBS No.	WBS No.
SAFE STORAGE			
RL-WT079-S	Double Shell Tanks (DST) Corrosion Chemistry	ORP-TW03	5.01.03.05
CLOSURE			
RL-WT035-S	Moisture Flow and Contaminant Transport in Arid Conditions	ORP-TW09	5.04.01.03
		ORP-TW11	5.05.01.01
RL-WT044-S	Distribution of Recharge Rates	ORP-TW09	5.04.01.03
		ORP-TW11	5.05.01.01
RL-WT046-S	Getter Materials	ORP-TW04	5.02.01.01.02.02
		ORP-TW09	5.04.01.03
		ORP-TW11	5.05.01.01
RL-WT053-S	Contaminant Mobility Beneath Tank Farms	ORP-TW11	5.05.01.01

FY02 TANKS TECHNOLOGY NEEDS

SAFE STORAGE

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Double-Shell Tank (DST) Corrosion Monitoring
2 *	<i>Need Code:</i> RL-WT004
3 *	<p><i>Need Summary:</i> Corrosion monitoring of double-shell tanks (DSTs) is currently provided by process knowledge and tank sampling. Tanks found to be within chemistry specification limits are considered to be not at risk for excessive corrosion damage. There have been no direct corrosion monitoring systems for DSTs in use at the Hanford Site. However, maintaining DST wastes within chemistry limits has been problematic. Ultrasonic examination of DSTs through FY 2001 has gathered a growing body of evidence of material behavior under actual tank operating conditions. In some cases, these data appear inconsistent with the laboratory data that formed the basis for the waste chemistry specifications. Tank samples are infrequent and their analysis difficult and expensive. Waste streams that are exempt from the corrosion control specifications complicate process knowledge. In-tank, real-time measurement of the corrosive characteristics of the tank wastes is needed to improve control of corrosion processes.</p> <p>Recent ultrasonic examinations of DSTs indicated corrosion near the waterline in the form of pits (e.g., 101-AY, 102-AN). Such waterline corrosion is a result of a lack of adequate hydroxide concentration near the waste surface due to a reaction between carbon dioxide in the dome space air and hydroxide in the waste. The decrease in hydroxide concentration translates to a decrease in the pH of the waste near the waterline. It has been well known that at pH values less than 10, the carbon steel wall of the DSTs is prone to pitting attack. A decrease in pH could also occur underneath the waste surface in the supernatant and the sludge due to consumption of hydroxide by organics. Therefore, knowledge of pH of the waste is extremely beneficial in mitigating corrosion of the tank wall and extend its life. Probes to measure pH instantaneously in various environments are routinely used in the process industry. Probes with glass electrodes are usually limited for use in solutions with low ionic strength. The Hanford DSTs contain wastes with very high ionic strength and, therefore, the development of pH probes that can measure pH in very high ionic strength environments is needed. These probes, once developed, could be initially installed in the caustic deficient tanks to monitor the pH. The probes should be placed near the waste surface, in the supernatant and in the sludge. For use near the waste surface, a floating probe needs to be developed. These pH probes should also be able to withstand the high radiation environment of the DST wastes. This technology need also requires that the probes be designed of readily available materials that would lead to economic production of a large number of pH probes for installation in every DST. Therefore, this need calls for the implementation of a 1-year laboratory study for the design and development of a pH probe for use in high ionic strength and high radiation environments with additional time needed for deployment in the DSTs. This is a corrosion control issue and will affect all of the dilute waste storage tanks at Hanford, and may ultimately impact all 28 DSTs.</p>
4 *	<i>Origination Date:</i> FY 2000 (March 1999)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Tank Farm Operations <i>PBS No.:</i> RL-TW03
9 *	<i>National Priority:</i> X 1. High - Critical to the success of the EM program, and a solution is required to achieve the

	<p>current planned cost and schedule.</p> <p>2. <u>Medium</u> - 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).</p> <p>3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority: High</i>
PROBLEM DESCRIPTION INFORMATION	
11	<p><i>Operations Office Program Description:</i> 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.</p>
12	<p><i>Need/Problem Description:</i></p> <p>Corrosion control of high-level waste DSTs is currently provided by concentration limits on hydroxide, nitrite, and nitrate. Monitoring of the chemistry is provided by tank samples and process knowledge. As many as 4 DSTs at Hanford have operated outside of corrosion chemistry limits in recent years. Detection and remediation of these low hydroxide tanks has been slow and costly. Two of these tanks were brought into compliance during FY 2001. The remaining two are scheduled to be brought into compliance during FY 2002.</p> <p>Available technology for corrosion monitoring has progressed to a point where it is now feasible to monitor and control corrosion by on-line monitoring of the corrosion process and direct addition of corrosion inhibitors. Progress toward meeting this need has been made through the deployment of electrochemical noise probes in five Hanford tanks. These probes have generated data that improve insight to the extent and type of corrosion processes occurring as chemistry in the tank waste is adjusted. Additional work is needed to validate the conclusions and interpretation of data and to upgrade probe design for extended life. The potential benefits of a corrosion monitoring system include:</p> <ol style="list-style-type: none"> 1. Safer operation and reduced risk of primary tank failure, due to more timely identification and resolution of corrosivity conditions. Corrosion will be monitored directly, versus monitoring chemical species. Assumptions about tank waste homogeneity and accuracy of the corrosion chemistry specification will be reduced or removed. 2. Avoidance of unnecessary chemical additions: An estimated 100 to 200 metric tons of sodium, in the form of sodium hydroxide, will be added to the four double-shell tanks that are/were noncompliant with corrosion control specifications. Approximately \$7.5 million has been budgeted in FY 2001 and FY 2002 to bring the four tanks into compliance (in comparison, approximately \$500 thousand has been budgeted in FY2001 and FY 2002 for corrosion probe installation and monitoring). Also, because sodium may be a controlling constituent for production of vitrified waste, addition of sodium hydroxide for corrosion control during waste storage may result in higher downstream costs for production and disposal of higher numbers of HLW canisters. Quantification of this potential cost impact awaits process flow development by the

	<p>vitrification contractor. Direct monitoring of the actual tank corrosion conditions can potentially eliminate or reduce addition of sodium hydroxide to waste storage tanks for corrosion control.</p> <p>Corrosion control of DSTs is accomplished by operating the tanks within the corrosion chemistry specifications at pH in the range 11-13. Monitoring the chemistry of tank waste is performed using process knowledge and tank sampling. Tank samples are taken infrequently and their analysis is difficult and expensive. Process knowledge is complicated because of waste streams (notably line flushes and process condensate recycle) that are exempt from the corrosion control specifications. As tank waste chemistries change and hydroxide gets consumed, the waste becomes more aggressive toward tank steel wall. Tanks found to be within chemistry specification limits with a pH in the range of 11-13 are considered to be not at risk for excessive corrosion damage. However, four DSTs are currently operating with low hydroxide (out of corrosion specification) concentration, probably at a pH lower than the required range. Installation and operation of a properly designed pH probe will give an instantaneous indication of the pH of the tank waste and alert the tank farm operations if a corrective action such as caustic addition is needed. Therefore, a pH probe needs to be designed and deployed in the DSTs to continuously monitor the constantly changing chemistry conditions that lead to a lowering of pH below the required range.</p> <p><i>Consequences of Not Filling Need:</i></p> <p>Regulatory Impacts Waste compatibility is one area that must be addressed in tank system integrity assessments, per Washington Administrative Code (WAC) Dangerous Waste Regulations (WAC 173-303-640). There are no current regulatory requirements explicitly requiring deployment and monitoring of corrosion probes. However, Administrative Orders 00NWPKW-1250 and 00NWPKW-1251 issued by the Washington State Department of Ecology against DOE and the tank farm contractor require that corrosion probe data be incorporated into the DST System Integrity Assessment Report due in March 2006.</p> <p>Programmatic Impacts Process knowledge and tank sampling currently provide corrosion control of double-shell tanks. Tank samples are infrequent and their analysis difficult and expensive. Waste streams that are exempt from the corrosion control specifications complicate process knowledge. In-line, real-time measurement of the corrosive characteristics of the tank wastes will augment the current system to provide an enhanced level of corrosion control information and allow a more rapid response to adverse conditions. Data from corrosion monitoring supports estimation of remaining tank life and therefore supports Technology Insertion Point (TIP) milestone T03-05-300, "Assess Need for DST Replacement," due April 2005.</p> <p>Program Baseline Summary (PBS) No.: RL-TW03 Work Breakdown Structure (WBS) No.: 5.01.03.05 TIP No.: T03-05-300, "Assess Need for DST Replacement," April 2005, and T03-01-300, "On-Line Monitoring for Waste Tank Corrosion Control," June 2001 (new date proposed: September 2003)</p>
13	<p><i>Functional Performance Requirements:</i></p> <ul style="list-style-type: none"> • Identify waste chemistry conditions that are conducive to stress corrosion cracking (SCC). • Identify waste chemistry conditions that are conducive to pitting. • Order of magnitude quantification of mass loss during pitting and cracking. • Quantification of uniform corrosion rates • Conduct laboratory testing to better understand EN signals associated with SCC and

	<p>pitting.</p> <ul style="list-style-type: none"> Quantification of pH over the range of chemistry conditions in DSTs
***	Schedule Requirements: Work is to be completed by Fiscal Year 2002.
14	<i>Definition of Solution:</i> The successful solution will provide real-time data on tank waste corrosivity, including conditions conducive to SCC and pitting.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> TBD
17 *	<i>Potential Cost Savings:</i> TBD
18 **	<p><i>Potential Cost Savings Narrative:</i> The principal potential cost benefit of corrosion monitoring may be lower processing and disposal costs, resulting from elimination or reduction of sodium hydroxide addition to waste storage tanks for corrosion control. Quantification of this cost benefit depends on further development of the process flowsheet by the vitrification contractor. There is also the potential of lower costs for bringing tanks into compliance with the chemistry specifications if it can be shown by direct corrosion monitoring that less caustic need be added. There is an additional, though unquantified, cost benefit resulting from reduced uncertainty associated with understanding of corrosion processes in Hanford's DSTs. Improved understanding of corrosion processes leads to better decisions on managing risk of DST failure, including actions taken to prolong tank life, and decisions on tank replacement.</p> <p>The existing operating specification for DSTs prescribes waste chemistry requirements for the purpose of limiting corrosivity, and prolonging tank life. The DSTs will be needed well beyond their design life to support the future waste retrieval and treatment missions at the Hanford Site. Construction of new waste storage tanks could be required if remaining tank life is projected to fall short of the projected River Protection Project (RPP) mission duration. The estimated cost to build a new 6-tank farm (Multi-Function Waste Tank Facility) was \$435 million in 1993 dollars. It is difficult to quantify the benefit (in dollars) of knowing the pH conditions of the DST wastes. However, it is clear that decisions on corrosion inhibitor addition and DST replacement have the potential to significantly impact RPP life cycle costs in the range of 100s of millions of dollars. Continuous monitoring of DST waste chemistry by a pH probe and responding with a corrective action (e.g., caustic addition to tank waste) when needed would be a good justification for those decisions.</p>
***	<p><i>Technical Basis:</i> Real-time corrosion monitoring has been selected for preliminary evaluation at the Hanford Site. The use of such a system in Hanford waste tanks would allow for real-time monitoring of both corrosion processes and corrosion inhibitor addition. Real-time data collection would facilitate identification of the precise time when a corrosion process begins to occur in a tank. This, coupled with corrosion rate information also generated, would help in determining the extent of design life lost due to degradation by abnormal corrosion conditions. Similarly, real-time corrosion monitoring during inhibitor addition would allow one to observe corrosion conditions return to an acceptable level. Therefore, unnecessary inhibitor addition could be eliminated. The current system cannot offer this capability.</p> <p>Available techniques offer the ability to distinguish between uniform corrosion, stress corrosion cracking, pitting, and other forms of localized corrosion as they occur. They also generate uniform corrosion rate data identical to what is currently derived from chemical sampling. Some available corrosion monitoring techniques using electrical resistance probes or linear polarization resistance probes are not capable of distinguishing between uniform and localized forms of corrosion. These would not be considered acceptable. The most likely cause of failure in DSTs is degradation due to some form of localized corrosion.</p>

	<p>It has been well known that at pH values less than 10, the carbon steel wall of the DSTs is prone to pitting attack. Hydroxide concentration near the waste surface is continuously depleted due to a reaction between carbon dioxide in the dome space air and hydroxide in the waste. The decrease in hydroxide concentration translates to a decrease in the pH of the waste near the waterline. A decrease in pH could also occur underneath the waste surface in the supernatant and the sludge due to consumption of hydroxide by organics. Therefore, knowledge of pH of the waste is extremely beneficial in mitigating corrosion of the tank wall and extend its life.</p> <p>RPP-8173, Rev. 1 <i>Technical Basis for Caustic Additions to Tanks 241-AN-102, 241-AY-101, 241-AY-102, and 241-AN-107- DRAFT</i>, discusses the principle corrosion mechanisms (uniform corrosion, pitting, and stress corrosion cracking) that play an active role in DST primary wall corrosion and provides estimates of remaining useful lives for these tanks.</p> <p>BNL-52527, <i>Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks</i>, discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.</p> <p>DOE-STD-1073-93, <i>Configuration Management</i>, requires implementation of a Material Condition and Aging Management Program to control aging processes in major equipment and components. The primary aging processes in waste tank systems are corrosion related.</p> <p>DOE/RL-92-60, <i>Tank Waste Remediation System Functions and Requirements</i> contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions.</p>
19	<p><i>Cultural/Stakeholder Basis</i>: Maintaining DST integrity is a major issue of concern with the Washington State Department of Ecology and Hanford Stakeholders. This concern is reflected in Tri-Party Agreement milestones, review of the RPP EIS, and in other public documents.</p>
20	<p><i>Environment, Safety, and Health Basis</i>: HNF-SD-WM-TSR-006, <i>Tank Farms Technical Safety Requirements</i>, Administrative Control 5.15, <i>Chemistry Control Programs</i>. This document contains operational safety requirement - administrative controls for corrosion control, cathodic protection, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.</p> <p>DOE Order 5820.2A, <i>Radioactive Waste Management</i>, requires monitoring of cathodic protection systems, methods for periodically assessing waste storage system integrity, and adjustment of waste chemistry to control corrosion.</p> <p>HNF-SD-WM-OCD-015, <i>Tank Farm Waste Transfer Compatibility Program</i>, describes decision rules relating to waste transfers into and within the DST system. The document defines a means of consistently applying safety, operational regulatory and programmatic criteria and specifies considerations necessary to assess waste transfers.</p>
21	<p><i>Regulatory Drivers</i>: Washington Administrative Code 173-303-640(2)(c)(iii) requires consideration of existing corrosion protection when performing tank system integrity assessments. On-line corrosion monitoring may provide an acceptable performance measurement of current corrosion protection measures and early warning of potentially corrosive conditions.</p> <p>Administrative Orders 00NWPKW-1250 and -1251, issued by the Washington State Department of Ecology, require incorporation of corrosion probe data into the DST System Integrity Assessment Report, due March 2006 (Section 12).</p>

22 *	<i>Milestones:</i> (Draft) TPA Milestone M-48-14 requires completion of the DST System Integrity Assessment Report (including consideration of corrosion probe data) by March 31, 2006. Technology Insertion Point (TIP) milestone requires assessing the need for DST replacement by April 30, 2005.
23 *	<i>Material Streams:</i> Tanks and Residuals, HLW-HANF-3 (Double Shell Tanks), Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tanks
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge. For details, see, e.g., B. M Hanlon, "Waste Tank Summary Report for Month Ending June 30, 2001," HNF-EP-0182, Rev. 159, (CH2M HILL Hanford Group, Inc., Richland, WA, July 2001).
27	<i>Volume/Size of Contaminated Media:</i> 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. They are generally about a million gallons in volume.
28 *	<i>Earliest Date Required:</i> January 2003
29 *	<i>Latest Date Required:</i> September 2004
BASELINE TECHNOLOGY INFORMATION	
30	<i>Baseline Technology/Process:</i> There is no baseline technology for direct monitoring of corrosion in high-level waste tanks. Technology Insertion Point: T03-05-300, "Assess Need for DST Replacement," April 2005, and T03-01-300, "On-Line Monitoring for Waste Tank Corrosion Control," June 2001 (new date TBD)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline.</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs</i> M. A. (Mark) Roberts, CHG, 509-376-4852, F/509-376-5145, Mark_A_Roberts@rl.gov E.C. (Gar) Norman, CHG, 509-372-1963, Edgar_C_Gar_Norman@rl.gov R. P. (Mo) Anantamula, CHG, (509) 373-0785, Ramamohan_P_Anantamula@rl.gov K. G. (Kelly) Carothers, CHG, (509) 373-4556, Kelly_G_Carothers@rl.gov M. A. (Mark) Knight, CHG, (509) 373-1199, Mark_A_Knight@rl.gov Glenn Edgemon, Hiline Engineering, 509-943-9043, F/509-943-0856, glenne@hilineeng.com W. E. (Wes) Bryan, CHG, 509-373-9740, F/509-372-0065, Wesley_E_Wes_Bryan@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov Victor L. Callahan, ORP, (509) 373-9880, Victor_L_Callahan@rl.gov
36*	<i>Other Contacts:</i> D. H. (Dave) Shuford, CHG, 509-372-0703, F/509-372-1608, David_H_Dave_Shuford@rl.gov R. A. (Ryan) Dodd, CHG, 509-373-5629, F/509-372-3983, Ryan_A_Dodd@rl.gov K. A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

	A. F. (Anne-Marie) Choho, 509-372-8280, F/509-373-6382, Anne-Marie F Choho@rl.gov
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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**** ELEMENT OF A SITENEED STATEMENT REQUIRED BY CHG**

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Cleaning, Decontaminating and Upgrading Hanford Pits
2 *	<i>Need Code:</i> RL-WT021
3 *	<i>Need Summary:</i> Hanford desires an alternative to pit work baseline technology. Waste retrieval and transfer operations at Hanford will require extensive use of Single-Shell and Double Shell tank pits. Many of these pits will have to be modified, decontaminated, or prepped before waste can be transferred or retrieved from a tank. Current methods for modifying, operating, decontaminating, and installing equipment in these pits are labor intensive, costly, and result in a high worker dose. As an example, construction activities associated with Tank C-106 required pit access to install sluicing hardware and other equipment. The dose rate experienced in the 241-C-106 pits was 40 R/hr. After investing \$2 million and 5 months, worker dose had been reduced to only 20 R/hr. During the pit operations, 25 person rem's were accumulated.
4 *	<i>Origination Date:</i> FY 2000 (updated October 2001)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Operations and Retrieval PBS No.: -ORP-TWO3, -ORP-TW04
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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.</p> <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are</p>

	<p>being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the SSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms. <p>The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms.
12	<p><i>Need/Problem Description:</i> A significant number of pit entries will be required to modify, upgrade, and or install equipment to support waste retrieval and transfer operations at Hanford. Current methods for working in pits rely on pole tools, mirrors, and other extended reach hand tools to perform pit activities. These methods are labor intensive, costly, and result in a high worker dose. During FY00 remote technologies and deployment configurations were evaluated for Hanford tank farm pits. A procurement specification was developed and a commercial off the shelf remote arm and deployment platform was procured during FY01. The first deployment of the system will occur in FY02. Subsequent deployments in tank farm pits will allow operators to evaluate the effectiveness of remote technology, provide recommendations for improvements, and evaluate and adapt end effectors and other tooling configurations to operate with a remote system. The intend is to refine the functions and requirements for tank farm remote systems, develop improved remote system that adapt to a broader range of tank farm pits and condition, and develop the infrastructure and ancillary tools that will improve worker safety, reduce exposure and reduce cost.</p> <p>Consequences of Not Filling Need: For SST C-104 retrieval, 1 million dollars has been projected for required pit cleaning, decon and upgrades to install SST retrieval equipment. Several SST retrieval projects will be beginning construction activities in the 2004, 05, and 06 time frames that require pit modifications and/or pit work to install retrieval hardware. These include tanks C-104, S-112, and S-102. If 67 Hanford Site tanks must be retrieved, with potential pit decontamination cost per tank at 1 million dollars each, total costs could be excessive, thereby affecting critical enforceable tank waste remediation milestones.</p> <p>Program Baseline Summary (PBS) No.: RL-TW03, RL-TW04 Work Breakdown Structure (WBS) No.: 5.02.01.02.06.04.10, 5.01.03.04.02 TIP No.: Candidate</p>
13	<p><i>Functional Performance Requirements:</i> Improved methods of pit decontamination must reduce setup time and in pit debris/equipment removal time and thereby lower overall cost while at the same time reducing the dose received by the workers. Cleaning and decontamination methods should be able to reduce the background radiation in the pits better than present methods, which are only capable of a factor of 2 reduction. Specifically:</p> <ul style="list-style-type: none"> • Reduce the dose levels at the edge of the pit to as low as reasonably achievable by a combination of trash removal and decontamination. • Assist in the removal of heavy objects from the pit. • Assist with size reduction and debris removal • Provide jumper and connector measurements, accurate to $\pm 1/64$ in., so replacement/alternate jumpers can be fabricated without operator entry into the pit to obtain

	<p>measurements.</p> <ul style="list-style-type: none"> • Provide devices to support change out and/or install jumpers in less than one shift. • Perform as many pit decon and refurbishment operations as possible with the greenhouse roof in place. • Provide CCTV viewing of in-pit operations. <p>Possible Concept: A modular system would allow selection of required tools for the job at hand. The system should have a green house (confinement system) and shielding wall. The positioning system is capable of deploying various tools such as a reactionless impact wrench, a shears, and a band saw.</p> <p>Outsourcing Potential: All phases of this need have potential for commercial applications in facilities where remote operations are required.</p>
**	<p>Schedule Requirements: To support the Tri-Party Agreement M-45 series milestones, the current single shell tank retrieval schedule shows the start of pit cleanup and upgrade for tank 241-C-104 in June 2003. New methods of pit decontamination will be needed on this project. Future waste retrieval operations will require work in many of the contaminated pits. These operations will significantly increase in 2006.</p>
14	<p><i>Definition of Solution:</i> A system that improves on current methods for cleanup, decontamination, equipment removal and configuration changes, and other intrusive pit activities with resulting decrease in personnel exposure, decrease in cost, and schedule acceleration.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> There are a number of critical risks that this alternative reduces. These include:</p> <ul style="list-style-type: none"> • The risk of not being able to stage feed as fast as the WTPC Processing Rate (Critical Risk 9). • The risk of not being able to stage feed fast enough due to the need for adjusting off-spec feed (Critical Risk 22 and 25)
17 *	<p><i>Potential Cost Savings:</i> \$100,000,000</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Over 600 pits exist at the Hanford Site, representing a range of contamination and complexity. Recent experience on the W-320 Project required more than \$2 million for decontamination of a single pit, and was not completed sufficiently to allow manned entry.</p> <p>Reduced effort to make pits ready for piping modifications; over 600 pits – up to \$2M/pit.</p>
**	<p><i>Technical Basis:</i> Existing approaches rely on highly labor-intensive methods and unique job-specific tools. Improved methods can exploit technologies developed for remote handling, surface decontamination with chemicals, and mapping techniques. Small to significant adaptation may be needed.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> None identified for mapping or remote systems. Washington State Department of Ecology and tribal nations have concerns about use of chemical cleaning solutions that could escape the pit and accelerate contaminant transport in the vadose zone.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> Present methods require significant worker dose, particularly when manned entry is required for complicated tasks.</p>
21	<p><i>Regulatory Drivers:</i> Tri-Party Agreement including M-45 Series Single Shell Tank Retrieval milestones</p>
22 *	<p><i>Milestones:</i> RL09WT22TTP Milestone D.1-1, Complete C-104 heel pit hot deployment 12/15/01; D.1-2 Complete turnover of the Pit Viper system to CHG 4/13/02.</p>

	T03-05-051—M-43-00 Complete TF Upgrades—2/21/2006
23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity. 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> June 2001
29 *	<i>Latest Date Required:</i> 2003; additions and upgrades by September 2003
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Manual, long-reach tools, conventional decontamination and shielding techniques. Technology Insertion Point: Candidate
31	<i>Life-Cycle Cost Using Baseline:</i> TBD
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> TBD
33	<i>Completion Date Using Baseline:</i> TBD
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.W. (Dennis) Crass, NHC, 509-372-2034, F/509-373-4311, Dennis_W_Crass@rl.gov
35	<i>DOE End User POCs:</i> M.J. (Mike) Royack, DOE-OSD, 509-376-4420, F/509-376-9118, Michael_J_Royack@rl.gov
36 *	<i>Other Contacts:</i> A.H. (Al) Friberg, CHG, 509-376-1190, F/509-372-1608, Allen_H_Friberg@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> 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 *	<i>Need Code:</i> RL-WT022
3 *	<i>Need Summary:</i> 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 *	<i>Origination Date:</i> FY 2000 (3/24/99)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Tank Farm Operations PBS No.: RL-TW03
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> Comprehensive NDE of DST primary and secondary tank walls is required to ensure compliance with WAC 173-303-640 and Washington Administrative Order 00NWPKW-1250/1251.

	<p>by WAC commitment and for evaluations of remaining useful DST life. Ensuring the structural integrity of the current waste tanks while developing innovative solutions to waste management and consolidation is the main mission of contractors at the Hanford reservation.</p> <p>The next challenge in ensuring the integrity of the double shell tanks requires the examination of the knuckle region of the tank. This examination poses a significant technical challenge because a portion of the area that requires examination is not easily accessible. Initial studies conclude that detection of defects in the knuckle region is not a problem. However, characterizing the defect length and through wall extent presents a very difficult problem.</p> <p>TSAFT imaging technology is a promising technology that provides a potential solution for characterizing defects in the knuckle region of the waste tanks. The technology needs to be adapted to the geometry of the knuckle region and sound propagation distances of up to four feet.</p> <p>Consequences of Not Filling Need: <u>Regulatory Impacts:</u> 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 WAC-173-303-640. Completion of DST NDE was a part of these negotiations. Failure to complete this activity might be construed by WDOE as failure to comply with WAC commitments and WAC legal requirements. Washington Administrative Order 00NWPKW-1250/1251 requires examination of knuckle areas by FY2005.</p> <p><u>Programmatic Impacts:</u> If TSAFT technology is not developed, a majority of the high-stress region of the knuckle that rests on the concrete foundation may not be able to be examined. The inability to examine critical sections of the tank creates a major knowledge gap when attempting to assess the near- and long-term integrity of the tanks.</p> <p>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</p>
13	<p>Functional Performance Requirements: Functional requirements for ultrasonic inspection capable of characterizing defects in the knuckle region include:</p> <ul style="list-style-type: none"> • Propagating ultrasound a distance of four feet around a plate with a one-foot radius. • Detect cracks 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.
14	<p>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.</p>
14	<p><i>Definition of Solution:</i> Develop tools to examine currently inaccessible regions of the DST knuckles and bottom</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Provide assurance to WDOE that the DSTs are fit-for-service until mission completion</p>

	completion
17 *	<i>Potential Cost Savings:</i> n/a
18 *	<i>Potential Cost Savings Narrative:</i> 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 be 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.
**	<i>Technical Basis:</i> 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	<i>Cultural/Stakeholder Basis:</i> 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	<i>Environment, Safety, and Health Basis:</i> 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	<i>Regulatory Drivers:</i> Completion of the physical examinations of the DSTs is required by WAC commitment and as a prerequisite for obtaining Resource Conservation and Recovery Act (RCRA) permit status for continued 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 *	<i>Milestones:</i> TPA and WAC for FY2005
23 *	<i>Material Streams:</i> ID-2113 Sludge, Salt, Liquid Risk Score: 3 RL-HLW-20
24	<i>TSD System:</i> Double-Shell Tank System
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> FY 2003
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> 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	<i>Life-Cycle Cost Using Baseline:</i> TBD
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> TBD
33	<i>Completion Date Using Baseline:</i> FY2005
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> C.E. (Chris) Jensen, CHG, (509) 373-5058, Chris_E_Jensen@rl.gov G. P. (Gary) Duncan, CHG, (509) 376-6008, Gary_P_Duncan@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov Victor L. Callahan, ORP, (509) 373-9880, Victor_L_Callahan@rl.gov
36 *	<i>Other Contacts:</i> Ryan A. Dodd, CHG, 509-373-5629, F/509-372-3983, mailto:John_G_Kristofzski@rl.gov Ryan_A_Dodd@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

** ELEMENT OF A SITENEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Improved Double Shell Tank (DST) Integrity Nondestructive Examination (NDE) Measurement Tools
2 *	<i>Need Code:</i> RL-WT067
3 *	<i>Need Summary:</i> Compliance to Washington Administrative Code (WAC) 173-303-640 and Washington Department of Ecology (Ecology) Administrative Orders Numbers 00NWPKW-1250 and -1251 requires life cycle integrity assessments, including Non-destructive Evaluation (NDE) of all 28 DSTs. Current practice is to ultrasonically examine a 30-inch-wide vertical strip of the primary tank cylinder and heat-affected zones of selected horizontal and vertical welds, in each DST. This comprises approximately 1% of the primary tank wall, which raises issues as to the adequacy of the sample size.
4 *	<i>Origination Date:</i> FY 2000 (3/24/99)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Tank Farm Operations <i>PBS No.:</i> RL-TW03
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> Comprehensive NDE of DST primary and secondary tank walls is required to improve estimates of remaining useful DST life, and to provide reliable input to decisions on DST replacement. NDE equipment used to date requires a 24-inch riser for deployment, allowing access to only 10 to 12% of the circumference of each DST, through each of two such risers. Access is limited because a camera, with limited lighting and power/transmission cable length, guides remote operation of the NDE equipment. There are also obstructions, such as

	<p>air supply lines, preventing access to the rest of the wall.</p> <p>For convenience, the required 30-inch-wide vertical scan of the tank wall is aligned with the 24-inch riser providing access. A system that allowed relatively rapid screening of the entire vertical portion of the primary tank wall between air pipes (which deliver ventilation air for cooling to the tank bottom), would identify areas of primary concern within 10 to 12% of the primary tank surface accessible through a single 24-inch-diameter riser, and would provide a basis for selecting a preferred location for the 30-inch-wide more sensitive ultrasonic scan.</p> <p>Consequences of Not Filling Need: Issues regarding the representativeness of the roughly 1% of the tank surface ultrasonically examined using existing technology, and whether 1% is an adequate sample size, could be raised, potentially jeopardizing the acceptability and basis for the DST system integrity assessment report to be submitted March 2006 under the existing administrative orders.</p> <p>Program Baseline Summary (PBS) No.: RL-TW03 Work Breakdown Structure (WBS) No.: 5.01.03.05 TIP No.: T03-05-300, "Assess Need for DST Replacement," April 2005</p>
13	<p><i>Functional Performance Requirements:</i> Functional requirements for NDE include characterizing and locating flaws in heat-affected zones of welds, locating and sizing surface pits, and measuring wall thickness on 3/8-inch to 15/16-inch-thick plates on 75-ft-diameter walls. For wall thinning, the detection capability of existing NDE equipment is ± 0.02 inches. For pitting, the detection capability of current NDE equipment is ± 0.05 inches. The location of reportable indications shall be repeatable to within ± 1.0 inch. The required sensitivity of NDE equipment used for screening would be less stringent.</p> <p>The NDE system must be capable of performing reliably in rough surface conditions including, but not limited to, weld spatter, mill scale, rough weld surfaces, and corrosion compounds. The NDE screening equipment will be expected to perform in a high radiation area. The NDE screening equipment will also be expected to perform in high humidity environments and surface temperatures up to 180°F.</p> <p>Privatization Potential: A vendor with experience in application of NDE technologies for commercial use would do the development of the NDE screening equipment.</p>
***	<p><i>Schedule Requirements:</i> Technology Insertion Point (TIP) milestone T03-05-300 for the River Protection Project schedules a decision on DST replacement by April 2005. Ultrasonic examination of DSTs completed prior to that decision point will be used to establish a baseline indicating how well tanks have survived to date, and to improve estimates of remaining useful life. Availability of improved NDE screening tools in the period FY 2002 through FY 2005 would support validation of the representativeness of ultrasonic examination data used in estimating corrosion rates and remaining useful life of DSTs, and in integrity assessment of the DST system to meet Administrative Orders NWPKW-1250 and -1251 requirements.</p>
14	<p><i>Definition of Solution:</i> Develop a NDE screening tool to identify potentially problematic areas and select locations for NDE using existing equipment.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Less potential large negative impact on mission from potential early tank failure</p>
17 *	<p><i>Potential Cost Savings:</i> \$50,000,000</p>

18 *	<p><i>Potential Cost Savings Narrative:</i> Improved methods for ultrasonic examination of DSTs leads to better understanding of how tanks have survived to date, better estimates of remaining useful life, and better decisions on building or not building new tanks. The estimated cost to build a new 6-tank farm (Multi-Function Waste Tank Facility) was \$435 million in 1993 dollars. The adverse cost impact for building even one additional DST, if it is not needed, is therefore in the tens of millions of dollars. If DSTs failed (e.g., leakage through the primary shell into the annulus) prior to the end of their storage mission, costs associated with recovery actions, including schedule delays in the overall RPP mission, would also be large.</p>
**	<p><i>Technical Basis:</i> The Washington Administrative Code (WAC), Section 173, requires periodic integrity assessments. Ecology and DOE's Office of River Protection (ORP) have agreed to perform limited NDE by ultrasonic testing, on all 28 DSTs, as part of the required integrity assessments. The current NDE equipment uses a 24-inch riser for deployment, allowing access to 10 to 12% of the tank circumference, from each of the two 24-inch risers on each DST. Existing ultrasonic examination technologies cover approximately 1% of the DST primary tank vertical wall.</p> <p>A system that allows relatively rapid screening of the entire accessible area, through a 24-inch riser, will identify areas for subsequent examination using more sensitive NDE equipment. This would lead to improved assessment of existing tank conditions, and increased confidence in decisions on building or not building new waste storage tanks.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Given the history of single-shell tank failures and resulting contamination of soil and groundwater, uncertainty regarding existing DST conditions and rate of deterioration of DSTs by corrosion could raise stakeholder concerns.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> Assessing the integrity of the DSTs reduces the risk of leaks, by allowing early detection of any degradation of DSTs and timely corrective action, including tank replacement.</p>
21	<p><i>Regulatory Drivers:</i> <i>Washington Administrative Code 173-303-640(2)(c)(iii)</i> requires a physical examination (NDE) or leak test as a part of an integrity assessment program.</p> <p>Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251 provides additional examination requirements.</p>
22 *	<p><i>Milestones:</i> TIP Milestone T03-05-300, "Assess Need for DST Replacement", April 2005, and submit DST system integrity assessment report, March 2006, TPA Milestone M-48-14 (draft).</p>
23 *	<p><i>Material Streams:</i> ID-2113 Sludge, Salt, Liquid Risk Code: 3 RL-HLW-20</p>
24	<p><i>TSD System:</i> Double Shell Tank System</p>
25	<p><i>Major Contaminants:</i> 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)</p>
26	<p><i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.</p>
27	<p><i>Volume/Size of Contaminated Media:</i> 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.</p>
28 *	<p><i>Earliest Date Required:</i> FY 2002</p>
29 *	<p><i>Latest Date Required:</i> FY 2003</p>

Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> N/A <i>Technology Insertion Point(s):</i> T03-05-300, "Assess Need for DST Replacement," April 2005
31	<i>Life-Cycle Cost Using Baseline:</i> TBD
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> TBD
33	<i>Completion Date Using Baseline:</i> FY 2005
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> C.E. (Chris) Jensen, CHG, (509) 373-5058, Chris_E_Jensen@rl.gov G. P. (Gary) Duncan, CHG, (509) 376-6008, Gary_P_Duncan@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, 509-373-1313, E_J_Cruz@rl.gov V. L. (Vic) Callahan, ORP, (509) 373-9880, Victor_L_Callahan@rl.gov
36	<i>Other Contacts:</i> R. A. (Ryan) Dodd, CHG, 509-373-5629, Ryan_A_Dodd@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Use of Handheld Technology to Automate Operator Data Sheets for Tank Farm Operations: Surveillance Automation for Tank Farms.
2 *	<i>Need Code:</i> RL-WT072
3 *	<p><i>Need Summary:</i></p> <p>Nuclear Operations Project Services at CH2M HILL Hanford Group, Inc. (CHG) identified the need to improve manual tank farm surveillance data collection, review, distribution and storage practices often referred to as Operator Rounds.</p> <p>An opportunity exists to increase the efficiency of Operator Rounds associated with manual surveillance activities and to increase the usefulness of the data collected. The automation includes:</p> <ul style="list-style-type: none"> • Elimination of Operator Rounds data sheets • On-the-spot baseline criteria data checking • Reduction of rechecks • Elimination of data input • Provide shift supervisors methods to review data • Perform trending • Analyze equipment failures and data anomalies <p>Automation of the Operator Rounds datasheets would give real-time operational data and response capability to Operations, Engineering, and the Central Command and Control personnel.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Tank Farm Operations <i>PBS No:</i> RL-TW03
9 *	<p><i>National Priority:</i></p> <p>___1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>___X2. <u>Medium</u> - 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).</p> <p>___3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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</p>

	<p>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.</p> <p>Operator Rounds are performed by the Nuclear Operations Project Services at CHG in the 200 East and West area tank farms located at the Hanford site. A large percentage of tank farm <i>surveillance</i> data are manually collected on Operator Rounds data sheets on a daily, weekly, monthly, and quarterly basis. These Operator Rounds data sheets require daily review, database input (for some data types), distribution of the data sheets, and short and long-term storage.</p> <p>The overall concept to improve the manual method is to use handheld computer units, barcode/wireless technology, a database for storage and acquisitions, associated software, and operational procedures to increase the efficiency of Operator Rounds associated with surveillance activities. In addition, the Integrated Environment, Safety and Health Management System (ISMS) guiding principle of worker involvement warrants Field Operators participation in all aspects of the project.</p>
12	<p><i>Need/Problem Description:</i> A large percentage of tank farm <i>surveillance</i> data are manually collected on Operator Rounds data sheets, however, by automating the Operator Rounds data sheets on handheld computer units will increase the efficiency of Operator Rounds associated with surveillance activities. A single, one-time entry will be accomplished rather than writing information on data sheets and then entering the information into a computer (database). The automation includes <i>cost savings</i> of: elimination of Operator Rounds data sheets, on-the-spot baseline criteria data checking, reduction of rechecks, elimination of data input, provide shift supervisors methods to review data, perform trending, analyze equipment failures, and data anomalies.</p> <p>Program Baseline Summary (PBS) No.: RL-TW03 Work Breakdown Structure (WBS) No.: 5.01.03.01 TIP No.: N/A</p>
13	<p><i>Functional Performance Requirements:</i></p> <p><u>Hardware</u></p> <ul style="list-style-type: none"> • Must be able to withstand extreme temperature ranges without freezing or overheating. • Screens are easy to damage (e.g., scratches). Consider a protective screen over the display screen that can be easily replaced. • Ensure batteries are easily replaced without using tools (e.g., a screwed shut case). • Must handle a radiation field without losing data or the program. • Unit should have a timed shut down to save the battery when left "on" accidentally in a truck. • When the unit shuts off and then is restored, it should display the screen it was on. • Direct upload of data with confirmation that data was transmitted (i.e., wireless communication). • Ensure there is a back up battery to save data if main battery fails. • The field operators prefer a flat unit instead of the pistol grip unit, which may be easier to checkout of a radiation zone. • Ensure unit has sufficient memory to handle Operator Rounds for both East and West farms. <p><u>Software</u></p> <ul style="list-style-type: none"> • Provide the previous reading(s) next to the new reading to see changes. • Provide the additional symbols like OS (Out of Service), SR (Service Required) and a way to reference the "red circled" reading to the "EDL" (Equipment Deficiency List). • Need a way to alert the field operator if all the readings were done/were not done before exiting

	<p>the farm/facility.</p> <ul style="list-style-type: none"> • If not red circles to show failed/problem equipment/readings then an equivalent method of indicating a problem. • Need comment sections that can be updated by each operator as conditions change in the field. • Need ability to modify rounds by operations personnel. • Need ability to add temporary rounds (e.g., extreme weather rounds). • Need ability to type into the unit the location or alternate method to using a barcode.
***	<i>Schedule Requirements:</i> As soon as available.
14	<p><i>Definition of Solution:</i> There are existing technologies available commercially and those software and hardware products will be considered. An Accelerated Site Technology Deployment Proposal is being prepared in addition to this Science and Technology Needs Statement.</p> <p>Expect receiving organization to support in system requirements gathering, prototyping and testing of both hardware (handheld data acquisition device) and software. Operational testing would require “field” testing in the tank farms. Expect receiving organization to own the system.</p>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<p><i>Potential Benefits:</i></p> <ol style="list-style-type: none"> 1) Elimination of Operator Rounds data sheets. 2) Single, one-time entry of data when captured (a single pass through from the handheld computer unit to the database used for storage). 3) More readily reporting of the data that are collected. 4) Improved data communications from the field to the office for data review and trending analysis. 5) Improved data collection information, such as electronic procedures and previous readings (this information is available now, but is taken to the Field in hardcopy) 6) Minimizing rechecks reduces worker protection clothing necessary for the field, and most importantly, reduces time the Field Operator has to be in the tank farm.
17 *	<i>Potential Cost Savings:</i> \$800,000/Year
18 *	<p><i>Potential Cost Savings Narrative:</i> In summary, \$800,000 savings per year can be addressed in three areas:</p> <p><u>Field Preparation & Rechecks:</u> Since there will be an upload to the handheld computer unit, procedures and datasheets are electronic along with baselines for immediate notification to a Field Operator. Immediate notification is on screen output notifying Field Operator of out-of- range readings allowing on-the-spot rechecks and validation. Minimizing rechecks reduces worker protection clothing necessary for the field and most importantly reduces time the Field Operator has to be in the tank farm.</p> <p><i>Savings Estimate: \$300,000/Year</i></p> <p><u>Immediate Data Review & Trending Analysis:</u> Since data will be sent immediately to the database, a Shift Supervisor can review the data immediately for trending and reporting. There would be no data entry. The database will also ensure reporting is more readily available.</p> <p><i>Savings Estimate: \$200,000/Year</i></p> <p><u>Data Sharing & Reporting:</u> Much needed and improved data sharing with other applications will eliminate personnel searching for data. Currently, reporting of data has to wait until printed reports of data are collected for signature for Records Management purposes. Data stored in a database can be retrieved electronically, improving the availability of data versus the Operator Rounds data sheets filed in at the Technical Data Services Center. Data stored in svstem may be used to reduce</p>

	hard copy record keeping requirements by utilizing more advanced system security. <i>Savings Estimate: \$300,000/Year</i>
19	<i>Cultural/Stakeholder Basis: N/A</i>
***	<i>Technical Basis:</i> By automating the Operator Rounds data sheets to handheld computer units, the Field Operator will still travel from one piece of equipment to another gathering the surveillance data in various locations. However, the method of <i>communicating</i> the data will improve due to the data collection automation (use of handheld computer units). The technical basis is improving data management that enables a single pass through of data from the handheld computer unit to the database used for storage. The major cost savings of the technical basis is improving data communications by eliminating <i>manual</i> data entry.
20	<i>Environment, Safety, and Health Basis:</i> Since there will be an upload to the handheld computer unit, procedures and datasheets are electronic along with baselines for immediate notification to a Field Operator. Immediate notification is on screen output notifying Field Operator of out-of-range readings allowing on-the-spot rechecks and validation. Minimizing rechecks reduces worker protection clothing necessary for the field and most importantly reduces time the Field Operator has to be in the tank farm.
21	<i>Regulatory Drivers:</i> Since data will be sent immediately to the database, a Shift Supervisor can review the data immediately for trending and reporting. There would be no data entry. The database will also ensure that reporting is more readily available.
22 *	<i>Milestones: N/A</i>
23 *	<i>Material Streams:</i> Dilute Sludge, Salt, Liquid (RL-HLW-20), Tanks and Residuals, HLW-HANF-3 (Double Shell Tanks).
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank Systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity. 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> December 31, 2001
29 *	<i>Latest Date Required:</i> September 30, 2004 and potentially post 2020.
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> <i>Technology Insertion Point(s): N/A</i>
31	<i>Life-Cycle Cost Using Baseline: N/A</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost: N/A</i>
33	<i>Completion Date Using Baseline: N/A</i>
Points of Contact (POC)	

34	<i>Contractor End User POCs:</i> R. L. (Ronald) Nelson, CHG, (509) 372-1452, Fax (509) 372-8036, ronald_l_nelson@rl.gov
35	<i>DOE End User POCs:</i> E. J. (Joe) Cruz, DOE-ORP, 509-372-2606; F/509-373-1313; E_J_Cruz@rl.gov
36**	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov A. F. (Anne-Marie) Choho, 509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Cleanable HEPA filter
2 *	<i>Need Code:</i> RL-WT104
3 *	<p><i>Need Summary:</i> Most of the Hanford 169 Single Shell Tanks are passively ventilated. They are equipped with fiberglass filters, which are operating at a very low flow rate (under 10 cfm). High failure rates are being experienced with these filters, upon periodical aerosol testing. Failures are partially attributed to a combination of age (numerous filters are approaching end of life), and the low tolerance of the current filters to outside conditions such as dust and ashes from regional fires.</p> <p>The need is for a filter that would operate at flow rates of a few cfm, with a differential pressure of less than four inches (preferably one or two inches), and would be durable in the tank farm conditions. Durability could be achieved through periodic cleaning (a six month periodicity would be acceptable).</p>
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage <i>PBS No:</i> ORP-TW03
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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.</p>
12	<p><i>Need/Problem Description:</i> Most of the Hanford 169 Single Shell Tanks are passively ventilated. They are equipped with fiberglass filters, which are operating at a very low flow rate (under 10 cfm). High failure rates are being experienced with these filters. Failures are partially attributed to the low tolerance of the current filters to outside conditions such as dust and ashes from regional fires.</p> <p>***</p> <p>***</p> <p>***</p> <p>Program Baseline Summary (PBS) No.: TW03</p>

	Work Breakdown Structure (WBS) No.: 5.01.03.02 TIP No.: The needed device described in this need statement is needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).
13	<i>Functional Performance Requirements:</i> The need is for a filter that would operate at flow rates of a few cfm, with a differential pressure of less than four inches (preferably one or two inches), and would be durable in the tank farm conditions. Durability could be achieved through periodic cleaning (a six month periodicity would be acceptable).
***	<i>Schedule Requirements:</i> This is a current, ongoing operational need. Work underway to address the SRS problem has direct applicability.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$100K to \$1M per year
18 *	<i>Potential Cost Savings Narrative:</i> The cost savings will come primarily from the lower frequency of filter replacement.
***	<i>Technical Basis:</i> The Tank Focus Area is developing sintered metal and other cleanable filtering media. Their applicability to the SST low flow rate-low differential pressure case is to be assessed.
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i> Reducing the filter replacement frequency will reduce worker exposure risks.
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> Schedule risk will be reduced for all milestones related to tank farm activities supporting Safe Storage, Retrieval, and Closure, since premature failure of breather filters impacts Tank Farm work load and qualified staff availability.
23 *	<i>Material Streams:</i> TW03 - Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> End of Tank Farms mission (post 2020)
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: The needed device described in this need statement is needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>

33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.C. (Doug) Larsen, CHG, 509-373-5995, F/509-373-4275, Douglas_C_Larsen@rl.gov
35	<i>DOE End User POCs:</i>
36**	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Coalescer for Tank Waste in Pits and Airborne Contamination
2 *	<i>Need Code:</i> RL-WT105
3 *	<p><i>Need Summary:</i> Tank Farm work frequently requires the erection of tents to contain contamination from open pits or other areas. In case of contamination spread in the atmosphere of these tents, remediation is currently conducted by sweeping away the airborne contamination through ventilation. This process is very time consuming.</p> <p>The need is for a substance that could be spread, or any other action on a confined contaminated (tent) atmosphere, that would result in coalescing the airborne contamination into an easily recoverable form.</p> <p>Pits containing valves, pumps, and instrumentation are commonly contaminated with dried tank waste. Pit cleanup is required prior to performing maintenance and upgrade activities in the pits. Recovery of the waste from the pits is difficult.</p> <p>The need is for a substance that could be sprayed or flooded on the waste deposited in the pit, that would "gelify", or otherwise pre-condition the waste to ease its retrieval, by capturing the particles and prevent them from becoming airborne and spreading.</p>
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage, and Retrieval <i>PBS No:</i> RL-TW03 and RL-TW04
9 *	<p><i>National Priority:</i></p> <p>_____ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>_____ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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.</p>

	<p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms. <p>The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP <p>DSTs in a ready state for implementing closure and final disposal of the DST farms.</p>
12	<p><i>Need/Problem Description:</i></p> <p>*** Program Baseline Summary (PBS) No.: TW03; TW04</p> <p>*** Work Breakdown Structure (WBS) No.: 5.01.03.04.02; 5.02.01.02.06.04.10</p> <p>*** TIP No.: The needed devices described in this need statement are needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).</p>
13	<p><i>Functional Performance Requirements:</i></p>
	<p>*** <i>Schedule Requirements:</i> Ongoing operations need</p>
14	<p><i>Definition of Solution:</i></p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i></p>
17 *	<p><i>Potential Cost Savings:</i> \$100K to \$1M per year for all applications combined</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> The cost savings on the airborne contamination coalescer will come primarily from faster decontamination of tents, less resulting solid waste. The cost savings from the pit waste coalescer will come primarily from quicker pit cleanup, and cleaner pit, which reduces the risk of airborne contamination during pit work.</p>
	<p>*** <i>Technical Basis:</i> Coalescing substances are known to be used in other industries. Their application to Hanford the pit and containment tent environments is to be assessed.</p>
19	<p><i>Cultural/Stakeholder Basis:</i></p>
20	<p><i>Environment, Safety, and Health Basis:</i> One of the main purposes of the proposed development is to reduce workers exposure risk.</p>
21	<p><i>Regulatory Drivers:</i> Another significant outcome of the proposed development is a reduced risk of environmental contamination, since containment tents are limited in their containment capacity, especially during high winds.</p>
22 *	<p><i>Milestones:</i> The proposed development reduces schedule risks for all safe storage, retrieval, and closure milestones that involve work in contaminated pits.</p>
23 *	<p><i>Material Streams:</i> TW03 - Sludge, salt, liquid (RL-HLW-20)</p>

24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> End of Tank Farms mission (post 2020)
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: The needed devices described in this need statement are needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D. P. (Dan) Niebuhr, CHG, 509-373-4639, F/509-373-4275, Daniel_P_Dan_Niebuhr@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov M.J. (Mike) Royack, DOE-OSD, 509-376-4420, F/509-376-9118, Michael_J_Royack@rl.gov
36**	<i>Other Contacts:</i> D. W. (Dave) Strasser, CHG, 509-372-2405, F/509-373-5030, David_W_Strasser@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Double-Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools
2 *	<i>Need Code:</i> RL-WT106
3 *	<i>Need Summary:</i> Compliance to <i>Washington Administrative Code</i> (WAC) 173-303-640(2) requires the assessment of existing dangerous waste tank system's integrity. This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated, to ensue that it will not collapse, rupture, or fail. In addition, Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251 requires that by March 31, 2006 an integrity assessment report for the Hanford Site Double-Shell Tank System be submitted that assesses the integrity of the 28 DSTs and their ancillary equipment. The DST buried transfer pipelines are considered as ancillary equipment, and thus part of the DST system. Current practice for NDE examination of DST system buried transfer piping is to perform a visual examination and video recording of the condition of the piping when it is exposed by excavation activities as a result of conducting project related activities. This practice only allows for examination of the outer surface of primary transfer line or the outer surface of the secondary piping for lines that are double encased. Lack of more detailed information concerning the buried transfer line's condition and remaining wall thickness raises issues regarding its adequacy for service.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Tank Farm Operations <i>PBS No.:</i> RL-TW03
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<p><i>Need/Problem Description:</i> Comprehensive characterization of the condition of DST transfer lines is required to assess structural adequacy and compatibility with the waste(s) to be stored or treated and to ensure that the transfer lines will not collapse rupture or fail. Non-destructive examination data that characterizes transfer line remaining wall thickness, the extent of pitting and/or the extent of corrosion is required to fully assess the existing dangerous waste tank system's integrity per WAC 173-303-640(2). Accordingly, NDE data regarding the condition of the DST transfer lines is required to support development of the DST integrity assessment report in accordance with the Washington Department of Ecology Administrative Orders 00NWKKW-1250 and -1251 by March 31, 2006.</p> <p><i>Consequence of Not Filling Need:</i> A determination that the DST transfer lines are adequate and have sufficient strength and compatibility with the waste(s) to be stored or treated, to ensure that it will not collapse, rupture or fail, is at risk and could be challenged. Issues regarding structural adequacy of the lines could be raised, thus jeopardizing the acceptability of the DST system integrity assessment report to be submitted in March 31, 2006. In addition, transfer line failures could adversely impact planned waste processing activities, waste feed delivery schedules and scheduled completion of programmatic mission goals.</p> <p>*** Program Baseline Summary (PBS) No.: TW03</p> <p>*** Work Breakdown Structure (WBS) No.: 5.01.03.05</p> <p>*** TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> The NDE equipment must be capable of traversing the inside of the DST system transfer piping that ranges in size from 2-inch-diameter schedule 40 to 6-inch-diameter schedule 40, must be retrievable, and must be capable of characterizing wall thinning, pitting and corrosion. The equipment must be capable of identifying exact locations of any flaws or indications recorded. The NDE equipment must be capable of traversing pipe bends and performing reliably in a high radiation environment under field conditions on rough surfaces including, but not limited to, weld spatter mill scale, irregular weld joints, and corrosion compounds.</p>
***	<p><i>Schedule Requirements:</i> Availability of DST transfer line NDE equipment by the end of FY 2003 would allow time for conducting transfer line examinations to support preparation of the DST integrity assessment report by March 31, 2006, per Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251.</p>
14	<p><i>Definition of Solution:</i> NDE equipment capable of characterizing DST system transfer piping wall thinning, pitting and corrosion.</p>
15 *	<p><i>Targeted Focus Area:</i> Tank Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Offsetting of a potential large negative impact on mission goals/objectives due to a transfer line failure.</p>
17 *	<p><i>Potential Cost Savings:</i> n/a</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> This technology would not necessarily provide a cost savings, but would provide an additional method (besides pressure testing) for assessing integrity of transfer piping. Potential cost savings could result if flaws undetected by pressure testing were identifiable with this technology, thus reducing risk of failure during waste transfers. Quantification of such cost benefit would be highly speculative.</p>
***	<p><i>Technical Basis:</i> 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</p>

	potential for providing detailed characterization of cracking or corrosion in the entire knuckle region of the tanks.
19	<i>Cultural/Stakeholder Basis:</i> Given the history of single-shell tank leaks and other spills to the environment that have resulted in contamination and groundwater, uncertainty regarding existing DST system conditions and the rate of deterioration of ancillary equipment by corrosion could raise stakeholder concerns.
20	<i>Environment, Safety, and Health Basis:</i> Assessing the integrity of the DST system transfer lines reduces the risk of failure to meet programmatic mission goals and spills to the environment by allowing early detection of any degradation and timely corrective action, including transfer line replacement.
21	<i>Regulatory Drivers:</i> Washington Administrative Code (WAC) 173-303-640(2) requires physical examination (NDE) or leak test as part of an integrity assessment program. Washington Department of Ecology Administrative Orders NWPKW-1250 and -1251.
22 *	<i>Milestones:</i> Submit DST system integrity assessment report by March 31, 2006 per Washington Department of Ecology Administrative Orders NWPKW-1250 and -1251.
23 *	<i>Material Streams:</i> TW03 - Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2003
29 *	<i>Latest Date Required:</i> FY 2003
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> N/A <i>Technology Insertion Point:</i>
31	<i>Life-Cycle Cost Using Baseline:</i> N/A
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> N/A
33	<i>Completion Date Using Baseline:</i> FY 2006
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D. L. (Dave) Becker, CHG, 509-373-5302, F/509-372-0065, David.L.Becker@rl.gov G. P. (Gary) Duncan, CHG, 509- 376-6008, F/509-372-0065, Gary.P.Duncan@rl.gov
35	<i>DOE End User POCs:</i> V. L. (Vic) Callahan, ORP, 509*373-9880, F/509-373-1313, Victor.L.Callahan@rl.gov E. J. (Joe) Cruz, ORP, 509-372-2606, F/509-373-1313, E.J.Cruz@rl.gov
36 ***	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth.A.Ken.Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Grab Sampling Dose Reduction
2 *	<i>Need Code:</i> RL-WT107
3 *	<i>Need Summary:</i> Upgrade the grab sampling equipment to reduce radiation local exposure, improve upon the operability, reduce waste generation, while supporting sampling requirements for the Double Shell Tank Life Extension Project and other on-going sampling (e.g., Single Shell Tank retrieval demonstrations and studies supporting waste feed delivery planning for the Waste Treatment and Immobilization efforts.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage – Characterization <i>PBS No:</i> RL-TW03
9 *	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> X </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> In order to reduce dose exposure and simplify the grab sampling operation to meet future sampling requirements the following will need to be developed: 1. Replace the current disposable glove bag with a stainless steel glove box. The disposable glove bag requires temporary shielding and high spare parts inventory. Converting to the steel glove box will reduce spare parts inventory. Thus reducing the amount of mixed waste in the grab sampling campaign for disposal. Using the steel glove box will also eliminate the need for temporary shielding, reducing sampling time by decreasing the inspection time for the glove box, and eliminating one operator from the sampling crew. 2. Relocate the retrieval device from top of the glove bag/box to inside the side port of the glove

	<p>bag/box by using an "off-the-shelf model". This relocation move will eliminate the requirement for the operator to stand on a ladder and reduce his radiation exposure received from the shine from the open riser. The redesign of the retrieval device will also reduce the current grab sampler retrieval cost and eliminate long delivery of parts by going to an "off-the-shelf model".</p> <ol style="list-style-type: none"> Develop a containment housing and stand for the new hand winch retrieval assembly for use in either the glove bag or those occasions where one must sample over open riser. Modify the grab sampler cage (grab sampler assembly) to a hinge style so that extension tools can be used to remove the sample bottle. The current double bail model does not allow the use of extension tools to be used to remove the sample bottle from the sampler assembly. Modify the grab sampler cage to accept a 500 ml amber sample bottle. Amber sample bottles are currently used for the Evaporator campaign samples. Converting to the 500 ml amber sample bottle for the Evaporator campaign samples would reduce exposure by 50% for this sampling campaign. Modify the grab sampler cage to un-stopper and re-stopper the sample bottle at the desired depth. Modify the grab sampler cage release mechanism to reduce the stopper release force. In the 500 ml wide mouth sample bottle case, 85 lb_f must be overcome in order to release the stopper from the sample bottle when sampling a full tank. Segmented mast assembly Combination spray wash ring/riser adapter for mast decontamination Foot clamp sized for the mast requiring 60-100 psi Nitrogen or compressed air source. On application of pneumatic pressure, the Foot clamp jaws will open and allow movement or insertion of the mast segments. Upon loss of air, the Foot clamp jaws will close to retain the mast. Spray wash nozzles mounted in the top flange of the mast for the sample bottles. Bellows plate or transition assembly for mating with the glove box. <p> *** Program Baseline Summary (PBS) No.: TW03 *** Work Breakdown Structure (WBS) No.: 05.01.03.06.06.02 (Characterization) *** TIP No.: TBD; this will be put into operation as soon as available as noted in Schedule Requirements </p>
13	<i>Functional Performance Requirements:</i> See items 1-12 under the Need/Problem Description (section 12 above)
***	<i>Schedule Requirements:</i> Support Characterization Project Operations ongoing sampling such as support for caustic addition for Double Shell Tank Life Extension, for saltwell pumping (Interim Stabilization), and planning for feed delivery to the Waste Treatment Plant
14	<i>Definition of Solution:</i> A cold tested working unit ready for operational readiness review and subsequent hot deployment.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> The major benefit is radiation dose exposure reduction. Operating crew currently receiving 200-300mR/yr under the current operation. The proposed modifications to the grab sampling operation is estimated to bring the whole body exposure to 100-150mR/yr..
17 *	<i>Potential Cost Savings:</i> \$70,000/yr
18 *	<i>Potential Cost Savings Narrative:</i> Potential cost savings found in the reduction of spare parts that must be maintained in warehouse inventory, reduction in mixed waste disposal costs, eliminate the paper work involved in temporary shielding permits, elimination of glove bag inspection that take 1-1.5 hours to perform in the field, and reduction in whole body dose.

19	<i>Cultural/Stakeholder Basis:</i> Stakeholders strongly support the DOE and OSHA compliance with ALARA considerations for personnel radiation exposure.
***	<i>Technical Basis:</i> As Low As Reasonably Achievable (ALARA) considerations for personnel radiation exposure are a corner stone of worker safety and engineering considerations for equipment design and operation in the Tank Farms.
20	<i>Environment, Safety, and Health Basis:</i> Both DOE and OSHA requirements dictate ALARA considerations for personnel radiation exposure.
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> M-45 series single shell tank retrieval TPA milestones, interim stabilization milestones, waste feed delivery for the Waste Treatment Plant
23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated salt cake/and or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep and are similarly buried.
28 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> When the Hanford Waste Treatment and Immobilization Plant is ready to receive the last of the retrieved High Level Waste (HLW) feed for staging currently scheduled for the 2020's.
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: Supports M-45 series; Interim stabilization, and waste feed delivery to Waste Treatment Plant as well as DST Life Extension. TBD; this will be put into operation as soon as available.
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i> 2028
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> R. N. (Rob) Dale, CHG, 509-373-9207, F/509-373-4238, Robert_N_Rob_Dale@rl.gov
35	<i>DOE End User POCs:</i> Wen-Shou Liou, ORP, 509-373-9879, F/509-373-1313, Wen-Shou_Liou@rl.gov
36***	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> In-Tank Camera and Lighting
2 *	<i>Need Code:</i> RL-WT108
3 *	<p><i>Need Summary:</i> Storage, Retrieval, and Closure preparation activities currently require frequent in-tank camera observations. The current (intrinsically safe) cameras, although significantly improved over the recent years, still have significant weaknesses or limitations: lens fogging (due to warmer atmosphere in the tanks than outside), and gear constraints are the main issues. Gears either lack robustness, i.e. strip out and prematurely fail, or are not capable of tilting high enough to reach the tank dome. In addition, there is only one known supplier for cameras that meet the minimum tank farm requirements, which creates a significant mission risk.</p> <p>The need is for an intrinsically safe camera, radiation resistant, that can be deployed in a four-inch riser, includes a lens defogging system (e.g. purge air blow), robust gears, and can be tilted to reach the tank dome. Such a camera would not only improve today's operations cost and schedule, but also significantly reduce the current single supplier risk.</p> <p>Adequate in-tank lighting is required for in-tank camera observations. The two types of lights used today are very limited in the distance effectively covered, and provided colored light only: 75 watt lights that are qualified for flammable gas environments are attached to the cameras, and 1000 watt sodium lights are used in non-flammable gas environments. The lights need to be deployable in a four-inch riser. Vendors were consulted and could not provide equipment meeting the requirements.</p> <p>The need is for a lighting system that includes multiple lights used alternatively or simultaneously depending on the need, within flammable gas environments, providing clean white light, and deployable in a four-inch riser.</p>
4 *	<i>Origination Date:</i> November December 14, 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage, and Retrieval <i>PBS No:</i> RL-TW03 and RL-TW04
9 *	<p><i>National Priority:</i></p> <p>☐ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>☒ 2. <u>Medium</u> - 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).</p> <p>☐ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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

	<p>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.</p> <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<p><i>Need/Problem Description:</i></p> <p>There are occasions where the in-tank conditions necessitate more and brighter light in order to get satisfactory images. These conditions include fogging in tanks with dome space ambient temperatures that are above outside air temperatures, and tanks where waste disturbing processes are occurring that add aerosols to the tank dome space.</p> <p>In addition to this, the geometry of the tank is an issue. The current technology incorporates the use of a single 75 watt bright white light to view across a distance of up to 75 feet. This is insufficient lighting to view all the necessary detail due to the distances and subsequent light diffusion involved. For some Single Shell tanks with low flammability ratings, a supplemental 1000 watt light is available which provides excellent coverage, but this cannot be used in the Double Shell tanks. A similarly bright light (1000 watts of bright white light) for use in Double Shell tanks is highly desirable, as this will add detail and definition to video imaging.</p> <p>Program Baseline Summary (PBS) No.: TW03 Work Breakdown Structure (WBS) No.: 5.01.03.04 TIP No.: The needed camera and lighting described in this need statement are needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).</p>
13	<i>Functional Performance Requirements:</i>
	*** <i>Schedule Requirements:</i> Ongoing operations need.
14	<i>Definition of Solution:</i>
15	* <i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17	* <i>Potential Cost Savings:</i> \$100K to \$1M per year
18	* <i>Potential Cost Savings Narrative:</i> The cost savings will come primarily from reduced camera repair/replacement frequency, and higher efficiency of in-tank activities, such as retrieval, thanks to better camera images.
	*** <i>Technical Basis:</i> The current (intrinsically safe) cameras, although significantly improved over the recent years, still have significant weaknesses or limitations: lens fogging (due to warmer atmosphere in the tanks than outside), and gear constraints are the main issues. The two types of lights used today are very limited in the distance effectively covered, and provided colored light only: 75 watt lights that are qualified for flammable gas environments are attached to the cameras.

	and 1000 watt sodium lights are used in non-flammable gas environments.
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> The proposed development reduces schedule risks for all safe storage, retrieval, and closure milestones that involve camera-supported work.
23 *	<i>Material Streams:</i> TW03 - Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> End of Tank Farms mission (post 2020)
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: The needed camera and lighting described in this need statement are needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> M.L. (Mike) Sumsion, CHG, 509-376-4643, F/509-373-3404, Michael.L.Sumsion@rl.gov D. P. (Dan) Niebuhr, CHG, 509-373-4639, F/509-373-4275, Daniel.P.Dan.Niebuhr@rl.gov
35	<i>DOE End User POCs:</i>
36 ***	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth.A.Ken.Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Radiation Survey
2 *	<i>Need Code:</i> RL-WT109
3 *	<i>Need Summary:</i> A radiation dose rate survey is required when performing waste transfers through transfer lines. This survey must be performed periodically along the length of the line and consumes time and resources. A device that would remotely monitor the dose rates along the transfer line could save time, money, and reduce the radiation exposure to personnel.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage and Retrieval <i>PBS No:</i> RL-TW03
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> *** Program Baseline Summary (PBS) No.: TW03 *** Work Breakdown Structure (WBS) No.: 5.01.03.01 *** TIP No.: The needed devices described in this need statement are needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).
13	<i>Functional Performance Requirements:</i> TBD
	*** <i>Schedule Requirements:</i> Ongoing operational need.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)

16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$110K to \$1M per year
18 *	<i>Potential Cost Savings Narrative:</i> The cost savings will come primarily from less field labor-intensive surveys.
**	<i>Technical Basis:</i> As Low As Reasonably Achievable (ALARA) considerations for personnel radiation exposure are a corner stone of worker safety and engineering considerations for equipment design and operation in the Tank Farms.
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i> The proposed development will result in less time spent in radiation/contamination areas by the workers.
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> None specifically impacted.
23 *	<i>Material Streams:</i> TW03 - Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems.
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> End of Tank Farms mission (post 2020)
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: The needed devices described in this need statement are needed at any time in the Tank Farms mission, until the end of tank retrieval (two decades at least).
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.R. (Darin) Hekkala, CHG, 509-373-2360, F/509-373-0181, Darin_R_Hekkala@rl.gov
35	<i>DOE End User POCs:</i> M.J. (Mike) Royack, DOE-OSD, 509-376-4420, F/509-376-9118, Michael_J_Royack@rl.gov
36**	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Remote Tank Wall Repair
2 *	<i>Need Code:</i> RL-WT111
3 *	<p><i>Need Summary:</i> The Hanford Double-Shell Tanks (DSTs) will be used beyond their design life for storage and staging of waste for transfer to the Waste Treatment Plant. A tank integrity program is underway to assess the current condition of the tanks, and evaluate their life expectancy. During visual inspections, corrosion has been observed on the exterior of the primary tank, which presents the possibility of a localized failure. Penetration of the tank wall would result in taking a tank out of service, unless a remote repair can be performed. The schedule and cost impacts of taking a DST out of service before the end of its needed service would be very significant.</p> <p>A remote tank wall repair technology would reduce the mission risk significantly.</p>
4 *	<i>Origination Date:</i> October 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage <i>PBS No:</i> RL-TW03
9 *	<p><i>National Priority:</i></p> <p><u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u> </u> 2. <u>Medium</u> - 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).</p> <p><u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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.</p>
12	<p><i>Need/Problem Description:</i></p> <p>DSTs at Hanford are needed for storage and staging of waste feed for transfer to the Waste Treatment Plant that is scheduled to begin operation in FY 07. Surface corrosion has been observed on the exterior of the primary shell on several of Hanford's DSTs as part of the Corrosion Mitigation Program. Video inspections performed within the interior of Tank AY-101 have also observed stains originating at the previous waste level that may be a result of tank wall penetration.</p>

	<p>If a penetration or leak in Tank AY-101 or other DST is confirmed, the tank will most likely have to be taken out of service, further reducing the shortage of tank storage space. Localized repair of DST primary tank wall penetrations are required to prolong the life of the tanks to meet mission needs.</p> <p><i>Consequence of Not Filling Need:</i> Replacement of any of the DSTs would be extremely costly and time consuming resulting in even further delays to the waste feed delivery schedule. Waste management and staging for waste feed delivery would become extremely difficult if one or more tanks were taken out of service. At the very least, transfer routes would have to be changed or reconfigured which may also cause delays to waste feed delivery schedules.</p> <p>*** *** ***</p> <p>Program Baseline Summary (PBS) No.: TW03 Work Breakdown Structure (WBS) No.: 5.01.03.05 TIP No.: T03-05-300, "Assess Need for DST Replacement," April 2005</p>
13	<p><i>Functional Performance Requirements:</i> A system is required to make localized repairs to the primary tank wall by welding or some other means. The system must be deployed through riser penetrations into the tank annulus, and then operated remotely. The repair process must not cause any damage to the tank wall. The system must also be capable of testing repairs to verify integrity.</p>
***	<p><i>Schedule Requirements:</i> Development of a remote tank wall repair technology by the end of FY02 would coincide with NDE being performed at Tank AY-101 and would allow time for tank repairs prior to waste feed delivery need dates.</p>
14	<p><i>Definition of Solution:</i> Provide the technology for a system capable of repairing localized areas on the exterior of DST primary tank walls</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> A system to make localized repairs on DST primary tanks would eliminate the need to construct new tanks by prolonging the life of existing DSTs</p>
17 *	<p><i>Potential Cost Savings:</i> \$100,000,000 (per saved DST that would not need to be replaced)</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Cost savings would be approximately \$100,000,000 for each new DST that would not have to be constructed. Additional cost savings may result by not having to pay fines for schedule delays to the waste feed delivery schedule.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Maintaining DST integrity is a major concern with the Washington State Department of Ecology and Hanford Stakeholders. This concern is reflected in Tri-Party Agreement Milestones, review of the RPP EIS, and in other public documents. Further delays to the waste feed delivery schedule would raise stakeholder concerns as well.</p>
***	<p><i>Technical Basis:</i> The technology to make remote tank repairs currently exists, but needs to be applied to the configuration and conditions at Hanford.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> The RPP is committed to performing work safely and efficiently in a manner that protects the public, workers, and the environment, and accomplishes that objective through the integration of safety management into all facets of work planning and execution.</p>
21	<p><i>Regulatory Drivers:</i> Configuration and operation of these facilities is regulated under 40 CFR 265, Subpart J, and Washington's "Dangerous Waste Regulations," Washington Administrative Code (WAC) 173-303-640.</p>
22 *	<p><i>Milestones:</i> N/A</p>

23 *	<i>Material Streams:</i> N/A
24	<i>TSD System:</i> Double Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> FY 2003
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: T03-05-300, "Assess Need for DST Replacement," April 2005
31	<i>Life-Cycle Cost Using Baseline:</i> N/A
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> N/A
33	<i>Completion Date Using Baseline:</i> N/A
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> J. R. (Jim) Bellomy, III, 509-372-1673, J_R_III_Jim_Bellomy@rl.gov W. E. (Wes) Bryan. CHG, 509-373-9740, 509-372-0065, Wesley E Wes Bryan@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov Victor L. Callahan, ORP, (509) 373-9880, Victor L Callahan@rl.gov
36**	<i>Other Contacts:</i> R. A. (Ryan) Dodd, CHG, 509-373-5629, F/509-372-3983, Ryan A Dodd@rl.gov A. F. (Anne-Marie) Choho, 509-372-8280, F/509-373-6382, Anne-Marie F Choho@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Tank Farm Weather Enclosure
2 *	<i>Need Code:</i> RL-WT114
3 *	<i>Need Summary:</i> Construction and Maintenance tasks supporting both waste safe storage and waste retrieval are performed in the Hanford Tank Farms in contaminated pits where equipment such as valves, pumps, and interconnection pipes are located. Performance of these tasks frequently requires the erection of tents or green houses to control contamination. However, these structures do not provide a complete barrier to adverse weather conditions, such as high wind and rain. Construction work is regularly interrupted by such conditions due to the potential for wind-borne contamination spread and for industrial safety reasons. Installation of an enclosure over the work areas would reduce the environmental and worker risk, and the schedule and cost impacts of construction downtime associated with adverse weather conditions.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage and Retrieval PBS No: RL-TW03, RL-TW04
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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.</p> <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p>

	<ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the SSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<p><i>Need/Problem Description:</i></p> <p>Current safe storage operations at the Hanford Tank Farms involve waste transfers that require use of Double-Shell Tank and Single-Shell Tank pits. Safe Storage also requires pit upgrades for environmental regulation compliance. In addition, upgrades to the Tank Farms transfer system pits are required to support future retrieval of the waste and delivery to the Waste Treatment Plant. Examples of these ongoing and future pit activities are removal and replacement of jumpers, piping connection modifications, installation of instrumentation and hardware (pumps, etc), and decontamination of pits. Enclosures have been used at nuclear sites in the DOE complex and internationally, to shelter field operations while ensuring weather protection and adequate working temperatures. Enclosures have ranged from relatively large sized and permanent, to smaller sized and moveable. Two main types of design have been used: fabric-based, and metallic structures.</p> <p>Implementation in the Hanford Tank Farms involves specific issues, such as dome loading limitations, or interference with permanent above ground devices, and vehicles and crane circulation. Another technical issue is to minimize the air in-leakage into the enclosure, so as to allow for efficient dynamic containment (ventilation).</p> <p>***</p> <p>***</p> <p>Program Baseline Summary (PBS) No.: TW03, TW04</p> <p>Work Breakdown Structure (WBS) No.: 5.01.02.04, 5.01.03.04, 5.02.01.01.32, 5.02.02.02.0 (W-211), 5.02.02.03.01 (W-314)</p> <p>***</p> <p>TIP No.: This need will continue for as long as pit work is performed. Tank Farm Operations would benefit from a deployment at any time during the Tank Farm mission.</p>
13	<i>Functional Performance Requirements:</i>
	*** <i>Schedule Requirements:</i>
14	<i>Definition of Solution:</i> Several concepts could be considered, from a mobile small size enclosure (to cover one pit at a time), to a fixed large size enclosure (to cover a whole tank, or a whole tank farm). A recent study concluded that the most promising concept for a first time implementation at this time is the mobile pit-size enclosure. An Accelerated Site Technology Deployment Proposal is being prepared for this first deployment.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$ 1M to \$10M
18 *	<i>Potential Cost Savings Narrative:</i> Cost benefits will come primarily from not having to build new tents repeatedly (some tents are not used more than once today), and from reduced weather downtime. The first deployment proposed will lead to an estimated cost saving of \$1M.
	*** <i>Technical Basis:</i> Enclosures have been used at nuclear sites in the DOE complex and internationally, to shelter field operations while ensuring weather protection and adequate working temperatures. However, implementation in the Hanford Tank Farms involves specific issues, such as dome loading limitations, or interference with permanent above ground devices, and vehicles and crane circulation. Another technical issue is to minimize the air in-leakage into the enclosure, so as to allow for efficient dynamic containment (ventilation).
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i> The weather Enclosure will improve working conditions

	for pit work, and reduce contamination risk for both workers and the environment.
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> This technology will reduce cost and schedule risk for all milestones involving pit work.
23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> Post 2020
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: This need will continue for as long as pit work is performed. Tank Farm Operations would benefit from a deployment at any time during the Tank Farm mission.
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> Tarik Choho, NHC/CHG, 509-376-0590, F/509-372-2403, Tarik_Cchoho@rl.gov
35	<i>DOE End User POCs:</i>
36**	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Rapid Polychlorinated Biphenyl (PCB) Measurement System
2 *	<i>Need Code:</i> RL-WT117
3 *	<i>Need Summary:</i> Availability of a commercially available measurement system for congener specific PCB analyses.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage PBS No: RL-TW03
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> An EPA accredited technology is needed to measure the concentration of congeners of PCB compounds in highly radioactive waste samples. This technology is to be suitable for application inside hotcells, operated remotely, and insensitive to radiation levels commonly encountered in this environment. The existing laboratory methodology is very labor intensive, exposes personnel to ionizing radiation which is not ALARA compliant, and turnaround time of analytical results is poor. The result of these factors include the cost, about \$5000 per analysis, the number of samples a technician can prepare is limited by the radiation dose accumulated. Analytical data is not always available when needed by the user.
**	
**	Program Baseline Summary (PBS) No.: RL-TW03
**	Work Breakdown Structure (WBS) No.: 5.01.01.02, 5.01.03.06.01.04

	TIP No.: The requested technology would supplement or replace the baseline methodology in the Hanford Site laboratory(s) performing PCB analyses.
13	<p><i>Functional Performance Requirements:</i></p> <p>The system must be capable of performing the measurement on samples of solids, aqueous liquids, and liquids containing organic compounds. The system must quantitate the concentration of the congeners identified in method 8082 of the EPA compendium of procedures "Test Methods for Evaluating Solid Waste; SW-846". Detection limits must sufficient to assure the sample matrix is not regulated as a TSCA waste.</p> <p>The measurement must be capable of remote operation and provide an electronic output compatible with a common personal computer operating system.</p>
**	<p><i>Schedule Requirements:</i> Earliest Date Required: FY 2002; (Product would be used today, if available). Staging and transferring feed for the vitrification process will require rapid turnaround time on the most radioactive wastes in the FY 2007 time period. Design of the plant feed treatment process is in progress and the concentrations of PCB contained in wastes are important to the successful pretreatment module process design.</p> <p>Latest Date Required: Product would be used throughout retrieval and processing of tank waste.</p>
14	<i>Definition of Solution:</i> Availability of a low cost, commercially available PCB Measurement System
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<p><i>Potential Benefits:</i> The analyses identified in ORP-RPP interface control documents that must be performed prior to transfer of feed to the vitrification plant are extensive. Laboratory analyses are always expensive and time consuming, especially when the samples are highly radioactive and much of the sample preparation and analyses must be performed in a hotcell. PCB analyses are exacerbated by the long time the extraction and quantitation requires when the performed according to the standard EPA accepted procedure; therefore the cost is about \$5000 for each sample.</p> <p>The proposed rapid screening system is anticipated to reduce the cost of each analysis to about \$100 including the quality assurance that is required to assure the quality of the analysis. This system is also expected to reduce the number of reruns due to anomalous occurrences during the extraction and quantitation process since the procedure used will be greatly simplified. The time required to perform the analysis using this proposed technology is expected to be no more than 3 hours rather than the week or more with the standard method.</p>
17 *	<i>Potential Cost Savings:</i> \$100,000/tank of Waste Treatment Plant feed
18 *	<p><i>Potential Cost Savings Narrative:</i></p> <p>The cost of an analysis by the requested technology is expected to be about \$100, a saving of \$4900 for each sample. The same quality assurance and detection levels will be performed using this unit. Assuming ten samples make up each of two full depth samplings (20 samples) are required to characterize each shipment of feed to the vitrification plant. Almost \$100,000 could be realized in savings on each tank of waste prepared for transfer to the Waste Treatment Plant.</p> <p>In preparation for retrieval of wastes from single shell and double shell tanks, PCB analyses will be required in order to stage the waste feed such that it is acceptable to the Waste Treatment Plant. Delays in data availability are expected with the current technology because of the long time period required to perform the laboratory analysis.</p>

	<p>The technology is expected to be simple to operate; therefore, the analysis may be performed inside a hotcell by trained persons. This will significantly reduce the personnel radiological exposure and accelerate the availability of data by eliminating the steps necessary to load out aliquots from the hotcell and get them into the laboratory analyses schedule. No credit is calculated for radiation dose reduction.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> The Washington State Department of Ecology issues and monitors the operating permits of processes. They normally accept EPA accept measurement systems for the measurement of hazardous emissions and the proposed technology will have secured that acceptance.</p>
**	<p><i>Technical Basis:</i> ICD 19 and ICD 20</p> <p>No measurement system currently exists that can provide reliable, rapid PCB concentrations in waste tank samples. The only recourse is to perform a laboratory measurement that requires approximately one week to complete, exposes personnel to high levels of ionizing radiation, and costs approximately \$5000 for each sample. Acceptance criteria of waste volumes required by the ICDs includes PCB concentration data.</p> <p>The requested measurement system is expected to provide a means of reliably determining the concentration of all congeners of PCB compounds at the regulated concentration limit. Separation from the sample matrix produces no secondary or hazardous waste, and costs less than \$100 to produce results on each sample.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> The EPA methods are designed for analysis of soils and waters that do not contain radionuclides and therefore specify use of very large sample sizes. These methods have been modified for use on radioactive samples, however to meet detection limits, large sample aliquots are still required. The extraction of PCB into a matrix consistent with quantitation methodology is labor intensive and therefore is performed outside the hotcell. Personnel performing this operation are exposed to significant doses of ionizing radiation. It is expected that the proposed methodology will require a much smaller aliquot of the radioactive sample to meet the required level of detection and therefore reduce the radiological exposure significantly.</p> <p>The proposed system is expected to eliminate the need for large volumes of methylene chloride or other carcinogenic or hazardous compounds currently required by the EPA procedure.</p>
21	<p><i>Regulatory Drivers:</i> PCB containing materials are controlled by the Toxic Substances Control Act (TSCA) and the measurement methods are included in the EPA methods compendium after acceptance. Concentrations of PCB in vitrification plant feed will also be controlled to control the air emissions from that plant during the heating process. Some congeners, if not removed during feed pretreatment, can be expected to volatilize, without destruction, during the melt heating process. The concentration of PCB will be required to minimize pretreatment operations and assure that emissions will be within operational permit limits. There can be cost and schedule impacts if PCB concentrations are not available in time for feed delivery, which in turn can perturb completion of TPA milestones on schedule.</p> <p>The cost, provided above, includes testing and negotiation to have the measurement system qualified and accepted for use as a standard method of analysis by the EPA.</p>
22 *	<p><i>Milestones:</i> Success in meeting the requirements of interface control document 19, 20, 23, and the Regulatory DQO depend on the application of this proposed measurement system. All milestones and performance initiatives associated with meeting these requirements will be positively impacted.</p>

23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems
25	<i>Major Contaminants:</i> Pu-238, 239, 240, 241; AM-241; U-238; C-14; Nt-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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> Approximately 50 Mgal. 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> October 2001
29 *	<i>Latest Date Required:</i> 2005
Baseline Technology Information	
30	<p><i>Baseline Technology(ies)/Process:</i> The baseline technology uses the standard laboratory methodology approved by EPA and Washington Department of Ecology at a cost of approximately \$5000 for each analysis. This analysis is labor intensive and requires about a week to complete, generates a mixed waste, secondary waste stream that must be stored since no disposal options are currently available.</p> <p><i>Technology Insertion Point:</i> The requested technology would supplement or replace the baseline methodology in the Hanford Site laboratory(s) performing PCB analyses.</p>
31	<i>Life-Cycle Cost Using Baseline:</i> Assume 50 tanks will be sampled at multiple locations for acceptability for Waste Treatment Plant feed. As shown above, the cost of analysis per tank is \$100,000. Therefore the life-cycle cost for labor only is \$5,000,000. No credit is taken for the reduction of radiation exposure which at \$7,000 /person-rem could add an additional \$70,000 in cost savings (500 samples x 20 mrem accumulated dose per sample = 10 rem x \$7,000/rem = \$70,000)
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> The number of analyses for PCB concentrations required on the Hanford Site is more likely to exceed the estimation rather than be reduced. The number of analyses scheduled by the Waste Treatment Plant is not included in the estimates. Incidental requests on various wastes and support to blending activities of tank materials before final feed characterization have not been included in the previous estimates.
33	<i>Completion Date Using Baseline:</i> Approximately 2035
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> W.I. (Bill) Winters, NHC, 509-373-1951, F/509-373-2843, William_I_Bill_Winters@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov J.A. (James) Poppiti, DOE-HQ-EM-44, 301-903-1733, F/301-903-7604, james.poppiti@em.doe.gov
36**	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-3731-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

RETRIEVAL

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Remote Inspection of High-Level Waste Single-Shell Tanks (SSTs)
2 *	<i>Need Code:</i> RL-WT005
3 *	<i>Need Summary:</i> Sixty-seven of Hanford's 149 SSTs are known or suspected to have leaked roughly 1,000,000 gallons of waste to the vadose zone. There are indications that a small amount of this waste has migrated into the groundwater. All of Hanford's SSTs have exceeded their intended design lives and continue to degrade. The <i>Hanford Federal Facility Agreement and Consent Order</i> (Tri Party Agreement) schedule requires completion of a saltcake dissolution retrieval demonstration in single-shell tank (SST) S-112 during FY 2005. A crawler based, confined sluicing sludge retrieval demonstration in SST C-104 will occur during FY 2007 with completion of retrieval system construction during FY 2006. The first full-scale combined sludge/saltcake waste retrieval will occur in SST S-102 during FY 2006. Furthermore, under the M-23 Series of TPA milestones, requirements are established for SST integrity assessments. Capabilities for determining the leak integrity and structural integrity of SSTs are required to ensure safe storage of wastes in SSTs awaiting retrieval into the DST system and to assure successful retrieval of the waste from the tanks without causing leakage.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval and Safe Storage PBS No: RL-TW03 and RL-TW04
9 *	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> X </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The Retrieval & Disposal Program and the Storage & Closure Program are responsible for Program/Project Planning and Execution; Environment, Safety, Health, and Quality Assurance; Facility Operations; Engineering; Maintenance; Interim Stabilization; and Technology Development, Demonstrations, and Deployments necessary for the safe and cost effective storage, retrieval, disposal, and closure of SST wastes, associated underground storage tanks, and ancillary piping and equipment. Safe storage of wastes includes day-to-day operations of the SST's and DSTs and saltwell pumping operations to remove pumpable liquids from the SST's for transfer to double-shell tanks (DST's) to achieve interim stabilization and minimize the potential for SST leakage. Retrieval projects will be conducted to remove wastes from SST's for placement in DST's in support of waste feed delivery to the Waste Treatment Plant and eventual waste immobilization. An integral part of SST waste retrieval operations is leak detection, monitoring, and mitigation. Safe storage, retrieval, and closure activities associated with SST wastes are also supported by Special Projects and Vadose Zone Projects to characterize

	groundwater flow and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes.
12	<p><i>Need/Problem Description:</i> : 67 of Hanford's 149 SSTs are known or suspected to have leaked roughly 1,000,000 gallons of wastes into the vadose zone. There are indications that a small amount of this waste has migrated to the groundwater. All of the SSTs have exceeded their intended design lives and continue to degrade. The primary mode of failure has been determined to be stress corrosion cracking due to the lack of stress relieving during tank construction. Historically, the SSTs have leaked at a rate of 1.8 gallons/hr, however, in a few instances, there were catastrophic failures due to steam ruptures that buckled tank bottoms and released tens of thousands of gallons over a short period of time. Although the SSTs are of questionable leak integrity as evidenced by past tank leaks, there are no indications that the structural integrity of SSTs has been compromised using existing inspection methods. Current inspection methods include tank dome video surveys to look for cracking, spalling, and other tank dome anomalies, and tank dome deflection surveys. In addition, tank dome load limits have been established and are enforced to minimize the potential for tank dome collapse. Better methods for determining the leak and structural integrity of Hanford's SSTs is needed.</p> <p>Initially, SSTs that contain little or no waste could be selected for investigation of the tank walls, dome, and floor. If necessary, destructive metallurgical examination of small isolated sections of the SSTs may need to be performed to obtain a thorough understanding of the operating corrosion mechanisms. The number, size, and origin of the cracks that led to the leakage of waste for the leaking SSTs could be determined. Waste leakage rates should be confirmed based on the defect information, and the design of - liquid-based retrieval systems for retrieval operations needs to be evaluated for each selected SST to optimize the design and ensure minimization of leakage potential.</p> <p>Every effort should be made to perform the examination with a device that could be coupled to tank risers, or alternatively, a remote device with robotic features to more efficiently minimize costs. Capabilities to evaluate below the waste level along tank walls and bottom would be highly desirable. The potential benefits of NDE evaluation (and possible destructive evaluation of some of the SSTs) include:</p> <ul style="list-style-type: none"> • Optimizing the design of liquid-based waste retrieval methods for the SSTs. • Support evaluations of remaining/extended life and use of SST's. • Prioritization and sequencing of tanks for waste retrieval and processing based on suspect integrity. • Urgency with which leak mitigation actions need to be implemented. <p>Consequences of Not Filling Need: The DOE has previously entered into a Tri-Party Agreement commitment with Ecology and the U. S. Environmental Protection Agency (EPA) to begin full-scale waste retrieval technology demonstrations in FY 2005. Additional requirements for SST leak and structural integrity inspections are contained in the M-23 Series of TPA milestones. Failure to complete this activity might be construed by Ecology as failure to comply with Tri-Party Agreement commitments, WAC legal requirements, and failure to negotiate in good faith. Furthermore, evaluations of tank leak and structural integrity are necessary to ensure safe storage and retrieval of wastes currently contained in SSTs in a manner protective of human health and the environment. Similarly, understanding of the remaining tank life will support continued safe storage of wastes in SST's until such time it can be retrieved and processed, and support efforts directed towards the sequencing of SST waste retrievals to ensure that problematic SSTs are retrieved first for the greatest risk reduction.</p>

	<p>Program Baseline Summary (PBS) No.: TW03 and TW04 Work Breakdown Structure (WBS) No.: 5.01.02.02 and 5.02.01.01.02.02 TIP No.: NA</p>
13	<p><i>Functional Performance Requirements:</i> There are two categories of flaws to consider, non through-wall and through-wall. Non through-wall (partial penetration) needs to be evaluated to estimate the time to wall penetration. Through-wall flaws need to be evaluated to determine the potential for tank rupture and estimate rates of leaks that may occur in the future and assess appropriate actions.</p> <p>Acceptance criteria for NDE has the following allowable flaw sizes:</p> <ul style="list-style-type: none"> • Through-wall crack length-12 in. • Maximum allowable crack depth-3/16 in. • Thinnest allowable wall section-0.8t (where t is the original thickness) and • Maximum allowable pit depth-0.5t. <p>Ideally, the inspection method will be able to interrogate tank wall integrity at and below the waste level; including the tank walls, knuckle region, and dish bottom.</p> <p>Outsourcing Potential: Remote inspection capabilities developed at Hanford could be returned to the private sector. Industrial capabilities could be procured either as engineered systems, or as a subcontracted service.</p>
**	<p><i>Schedule Requirements:</i> Functional systems will first be useful if deployed prior to retrieval of waste from the SSTs, which is scheduled to begin by 2005. However, the benefits can be captured even with later deployments. If functional systems can be developed and proven prior to the beginning of actual waste retrieval, then they can become part of ongoing efforts to evaluate SST integrity using such approaches as in-tank video inspections and tank dome deflection measurements.</p> <p>Under the M-23 Series of TPA milestones, a SST In-Tank Surveillance & Monitoring Program Description Document is due by February 28, 2002. SST leak detection and monitoring Functions & Requirements are due by March 31, 2002. A SST System Integrity Assessment Report and Certification are due by June 30, 2002. The technologies and techniques developed and demonstrated in support of this need statement can formulate the baseline for routine tank integrity surveillance activities and support tank waste retrieval system designs and operations.</p>
14	<p><i>Definition of Solution:</i> The successful solution will have the capability to perform leak and structural integrity inspections on SST tank walls, domes, and bottoms at, below, and above the waste level. The solutions will be able to detect anomalies caused by stress corrosion cracking and other failure mechanisms to the length and depth specifications contained herein.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Liquid-based waste retrieval is considered to be one of the primary methods to retrieve waste from the SSTs. It is possible that liquid-based waste retrieval may not be a viable method for retrieval of some SSTs due to the extensive corrosion experienced by some of the tanks and the potential for causing tank leaks. In such cases, dry retrieval methods may become desirable. Therefore, it is important to initiate tank inspection to rule out liquid-based waste retrieval at an early stage, or implement appropriate leak mitigation measures, to have adequate time to pursue other retrieval methods prior to the 2005 deadline to initiate tank waste retrieval technology demonstrations for SST's.</p>
17 *	<p><i>Potential Cost Savings</i> \$500,000,000 to \$800,000,000</p>

18 *	<i>Potential Cost Savings Narrative:</i> Potential cost savings could be on the order of hundreds of millions of dollars by extending the life of SST's, avoiding the cost of building unnecessary new DST's, and possibly allowing the use of less costly waste retrieval methods.
**	<i>Technical Basis:</i> Liquid-based waste retrieval methods that use low volumes of liquids are the current approach for SST retrieval at Hanford (i.e., low volume density gradient saltcake dissolution, robotic crawler-based confined sluicing, and power fluidics). As such, it is necessary to know early what design and operating constraints are necessary to ensure that leakage will not occur during retrieval operations ; including leak detection, monitoring, and mitigation provisions. In addition, current methods for assessing SST integrity are limited to in-tank videos, tank dome displacement measurements, waste chemistry corrosion controls, and cathodic protection. A method does not currently exist for performing leak and structural integrity inspections of SST walls and floors below the waste level.
19	<i>Cultural/Stakeholder Basis:</i> The stakeholders are very concerned over potential waste leakage from SST's during the waste storage period preceding waste retrieval operations. Successful meeting of this need statement will help to support early identification of potential SST integrity issues to ensure proper establishment of priority for waste retrieval activities. Furthermore, knowledge of the potential leak and structural integrity of SSTs will help to optimize retrieval and LDMM system designs and operations.
20	<i>Environment, Safety, and Health Basis:</i> WHC-SD-WM-OSR-005, <i>Single-Shell Tank Interim Operational Safety Requirements</i> , WHC-SD-WM-OSR-004, <i>Aging Waste Facility Interim Operational Safety Requirements</i> . These support documents contain interim operational safety requirements – administrative controls for corrosion control, cathodic protection, tank dome load limits, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities. WHC-SD-WM-PLN-068, <i>TWRS Life Management Program Plan</i> , identifies stress corrosion cracking, pitting corrosion, and uniform corrosion as the primary aging mechanisms for DSTs. Studies of failed SST's have indicated stress corrosion cracking as the primary failure mechanism. This is due in part to the fact that the steel tank walls were not stress relieved during construction. BNL/DOE-HQ Tank Structural Integrity Panel, <i>Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT</i> , discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.
21	<i>Regulatory Drivers:</i> DOE-STD-1073-93, <i>Configuration Management</i> , requires implementation of a Material Condition and Aging Management Program to control aging processes in major equipment and components. The primary aging processes in waste tank systems are corrosion related. DOE/RL-92-60, <i>Tank Waste Remediation System Functions and Requirements</i> , contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions. The M-23 Series of TPA milestones establish requirements for SST leak and structural integrity inspections.
22 *	<i>Milestones:</i> T04-03-341, T04-05-100, T04-06-110, M-23 Series of TPA milestones
23 *	<i>Material Streams:</i> Sludge, Saltcake, Liquid (RL-HLW-20)
24	<i>TSD System:</i> N/A
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank wastes and vadose zone soils.

27	<i>Volume/Size of Contaminated Media:</i> Nominal capacities of SSTs range from 55,000 to 1,000,000 gallons
28 *	<i>Earliest Date Required:</i> 2/28/02
29 *	<i>Latest Date Required:</i> 9/30/04
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> There is no baseline technology for in-situ inspection of SSTs to assess corrosion damage. This is due largely to the lack of an annular area (like in DST's) for deployment of NDE techniques. For SST's, integrity is addressed through indirect techniques like waste chemistry controls, cathodic protection, video inspections, tank dome load limits, and measurement of tank dome deflections. Techniques have been developed to inspect tanks at the Idaho National Environmental Engineering Laboratory (INEEL) using an articulated arm and the Alternating Current Field Measurement technology, but these may not be applicable to Hanford Site SST's because the device is not designed to take readings below the level of the waste.</p> <p>The most promising technique may be an adaptation of the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization being demonstrated in support of DST knuckle-region inspections. The Center for Nondestructive Evaluation has a several methods that may be deployed using tank risers for interrogating the structural integrity of SST concrete domes. This requires further evaluation.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> C.M. (Chantho) Creze, NHC, 509-373-0973, F/509-373-6101, Chantho_M_Creze@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov</p>
36 *	<p><i>Other Contacts:</i> J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry_W_Cammann@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Representative Sampling to Support Operations and Disposal
2 *	<i>Need Code:</i> RL-WT009
3 *	<p><i>Need Summary:</i> A concept for taking representative samples and associated rapid analysis of feeds that are to be staged for cross site transfer or are to be staged as feed for the waste treatment and immobilization plant (WTP) needs to be developed and demonstrated. Feed for immobilization demonstrations must be sampled prior to transfer to WTP. The samples must be representative of the waste being sent to the WTP. In addition, reasonable process control information during staging and delivery of waste will be needed for process control during transfers and for optimizing the WTP process and for process control during the retrieval of waste from SSTs. The need can be stated in four parts: 1, sample mixed and staged high-level waste feed for the WTP to analyze for the purpose of waste feed acceptance (i.e. to confirm feed meets their regulatory and Authorization Basis requirements; 2, sample and analyze slurries in DST's during retrieval and staging of waste feed; 3, sample and analyze vertical solids concentration profiles during possible future full-scale mixer pump testing; and, 4, sample and analyze for process control information to support retrieval of SST waste and subsequent transfers of this waste in the DST system.</p> <p>To accomplish this, a variable depth or multiple depth sampling system is needed that can be operated in conjunction with the active mixing system in a waste feed staging tank to take representative samples. The samples must be representative of the point in the tank at which the samples are being drawn.. This knowledge will be needed for several purposes including acceptance of the waste feed batch by the WTP, ensuring that overall deliveries of waste (both slurries and supernatant) to the WTP are balanced in solids and sodium, optimizing throughput for the WTP (batch size and timing), and supporting transfers between DSTs of slurries retrieved from SSTs. In-line sampling and analysis technology may also be required.</p> <p>(References: <i>Alternatives Generation and Analysis for the Phase I Intermediate Waste Feed Staging System Design Requirements</i>, WHC-SD-TWR-AGA-001, Rev.0, DST Process Waste Sampling Subsystem Specification, HNF-5154, Rev 0).</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Opportunity—Hanford desires an alternative to the current or planned grab sampling and core truck baseline technology
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval and Transfer <i>PBS No.:</i> ORP-TW03, ORP-TW04
9 *	<p><i>National Priority:</i></p> <p>____ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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 and to meet environmental compliance for the WTP).</p> <p>____ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>

Problem Description Information	
11	<p><i>Operations Office Program Description:</i> Double Shell Tank (DST) and Waste Feed Delivery project maintains, operates and upgrades the DST System for continued safe storage and receipt of radioactive waste. Activities include transferring waste to waste treatment facilities, maintaining and evaluating operating and surveillance systems necessary for compliance with regulatory and AA/AB requirements, identifying if systems are reliable for this mission, transferring waste within the DSTs to manage the limited available space; characterizing waste to understand its properties, and developing flow sheets for waste treatment.</p> <p>The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms.
12	<p><i>Need/Problem Description:</i> A representative, and preferably also rapid, sampling system has to be developed and demonstrated so that supernate and HLW slurry feeds (Envelopes A, B, C and D) being sent to the WTP can be staged successfully to meet the required schedule and data quality objectives with a minimum impact on tank space and within guidelines for worker safety and ALARA considerations. There are several considerations:</p> <p><u>Sample Contamination</u> Current grab samplers consisting of "bottle-on-a-string" are used for slurry/supernate sampling. This system of sampling may produce cross contamination with material from higher elevations above the desired sample depth as it is withdrawn from the tank. This cross contamination could skew the sample results.</p> <p><u>Sampling while Mixing</u> High level waste sampling will be either grab sampling or core sampling per the current baseline. Neither of these methods can be performed during active mixing system operation. Grab sampling is a manual operation performed through an existing riser using a portable "glove bag" for containment control that has potential for personal contamination and exposure. Core sampling requires extensive setup and relatively long times to obtain a sample. . The AZ-101 pump tests showed that HLW can rapidly settle (7ft per hour) after mixer pumps are shutdown (RPP-6548, Rev 1). Due to the rapid settling rate, samples cannot be taken fast enough to be of any use for mixer pump test evaluation purposes.</p> <p><u>Process Control and Batch Certification</u> The rapid settling will impact waste content during a transfer operation, possibly requiring mixing while transferring. In addition, sampling while mixing, which cannot be done with base-line grab or core truck methods, will be required to assure that representative samples, including knowledge of vertical variation in solids content, are available for validation of a waste batch prior to transfer to the WTP. Independent evaluation of design criteria for an alternative system (RPP-7170) confirmed the need for a robust design that can sample while the mixer pumps are operating in HLW feed tanks.</p> <p><u>Sample Acquisition and Analysis Time</u> With the Hanford Site's existing capabilities it takes weeks or even months to sample and analyze a tank. As the disposal program activities involving 200 Area waste retrieval and privatization proceed, Hanford will need the capability to</p>

<p>*** *** ***</p>	<p>sample and analyze much more rapidly in order to ensure that the Tank Farm Contractor (TFC) provides feeds to support efficient operation of the WTP and with a minimum use of tank space. Representative sampling involving potentially non-homogeneous waste feed is definitely needed.. In addition, long sample and analysis times will cause operations to tie up tanks until analytical results are available to determine how the waste should be staged. Quicker sample/analytical responses will provide more flexibility to the tank system. Staging of waste for cross-site transfer will become a critical feature of timely staging of privatization feed as waste from the 200 W Area is utilized. In FY 2000, the number of feed tanks was expanded from two to over 12 for LAW and HLW feeds. A mobile sampling system that could be moved between feed tanks would be capable of providing verification samples and flexible to accommodate any changes in the feed schedule. A solution could consider a combination of fixed systems at key staging/blending tanks and a mobile system for other source DSTs. On-line analysis techniques of key parameters and waste constituents would also improve timeliness of information availability and flexibility of operations, especially in the area of process control. Consequences of Not Filling Need: Waste treatment and immobilization plant feed may not be delivered by the TFC on schedule and facilities may be idle while alternatives are identified and implemented. This could significantly increase the cost of the final disposal. CHG team staff will experience greater radiation exposure both in the field taking samples by current methods, and in the analytical laboratory handling the additional samples. Less accurate grab samples will be used which may result in feed that does not initially meet specifications (i.e., requires rework prior to transfer to the WTP feed staging tank). Greater risk of plugging the cross-site transfer lines and lines used for the retrieval of waste from SSTs; increased delay in making transfers; possible slippage of retrieval schedules. Critical process control decisions (e.g. is the waste adequately suspended, should the waste be blended, how much pump inlet dilution is required to pump the waste) may have to be made with less than adequate information.</p> <p>Program Baseline Summary (PBS) No.: TW03, TW04 Work Breakdown Structure (WBS) No.: 5.01.03.06.06 TIP No.: T01-01-108 "Deployment Decision for Selecting Technology for RPP Representative Sampling of Phase I Privatization Feed Staging Tanks", 5/31/2002.</p>
13	<p><i>Functional Performance Requirements:</i> Alternative feed staging strategies are being developed to better integrate the full waste feed staging, delivery, treatment, and immobilizing process. These may eventually supersede the requirements stated in ICD-19 and ICD-20, which were developed under the previous, cancelled privatization contract. A new strategy may consider blending of HLW and LAW waste in the TFC tanks to balance the amount of solids and sodium being sent to the WTP. Such a process control strategy will determine the functional requirements of the sampling and analysis methods to meet this need. The sampling and analytical capabilities should be able to determine if waste samples are within the specifications of waste Envelopes A, B, and C and Envelope D. The supernate solutions (Envelopes A, B, or C) to be sampled are targeted to be dilute slurry/supernate solutions with a maximum of 2% solids by weight. The HLW slurry will contain a mixture of liquids (Envelopes A, B, or C) and solids (Envelope D). The feed concentration of the Envelope D unwashed solids will be between 10 and 200 g/L. The samples will be drawn from the tank with a lift distance of up to 57 ft. The system to be provided will need to be deployed using existing spare tank penetrations that range from 6-in to over 12-in. for the HLW feed tanks. The sampling system shall provide required support subsystems as necessary to meet safety and operational requirements. The feed needs to be sampled and analyzed for these activities consistent with as low as reasonably achievable (ALARA) principles. (Reference: <i>Preliminary Level 2 Specification for the Nested Fixed-Depth Fluidic Sampler</i>, HNF-3483, Rev. 1).</p>

	<p>Possible concept: On-line sampling could satisfy this need. One vendor, AEA Technology (AEA), has developed the capability of obtaining representative samples of slurries of waste with a fluidics sampling pump. This concept was adapted for Savannah River Site waste tank use. If this device were configured as a mobile system to be deployed in the feed tanks, this need could be satisfied, including unanticipated changes in waste feed schedules.</p> <p>Outsourcing Potential: The representative sampler could be supplied and possibly also installed by AEA Technology, or through subcontracts to AEs administered by CHG. One version of a sample distribution manifold system is available through British Columbia Research Inc., a Canadian technology development firm..</p>
***	<p><i>Schedule Requirements:</i> To support the first certification of HLW feed to the WTP new sampling system should be available for use in mid 2005. Prior to this detailed designs and hazards assessments for the sampling system need to be completed and the hardware must be fabricated, accepted and checked out in cold test facilities. . The Technology Insertion Point, T01-01-108, for this activity follows the completion of cold testing prior to deployment in the first actual tank for hot testing. The cross-site transfer line from Tank 102-SY became operational in FY 1999; this sampling and analysis capability could potentially be beneficially employed anytime in the future.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<p><i>Potential Benefits:</i> There are a number of critical risks that this alternative reduces. These include: 1) the risk of not being able to stage feed as fast as the WTP's Processing Rate (Critical Risk 9); 2) the risk of not being able to stage feed fast enough due to the need for adjusting off-spec feed (Critical Risk 22 and 25); 3) the risk that there will be disputes over the analysis of the waste (Critical Risk 31). An additional risk is an unanticipated change in the waste batch feed sequence. In addition to these critical risks, there are a number of lower level risks that this alternative reduces. A more detailed discussion of both the critical risks and the lower level risks are contained in the <i>Nested, Fixed Depth Fluidic Sampler and Analysis System Deployment Strategy and Plan</i>, HNF-2906, Rev. 1, February, 2000. The total list of risks considered is contained within the Tank Waste Remediation System Retrieval and Disposal Mission Critical Risk List, Attachment 5 of HNF-2019, Rev 1, and the Waste Feed Delivery Risk List.</p>
17 *	<i>Potential Cost Savings:</i> \$10,000,000 (shown in TW03 only)
18 *	<p><i>Potential Cost Savings Narrative:</i> Setup time for sampling would be reduced and less personnel exposure will result in a cost reduction from current levels. A significant cost savings associated with the manpower to both take and analyze the samples would be achieved if an on-line instrument were developed. The cost of taking and analyzing samples currently is on the order of \$400K to \$500K per sample. In the future as more tanks are being retrieved, more cross-site transfers will need to be made with less elapsed staging time to avoid the need for additional cross site transfer lines and additional staging tanks.</p> <p>Reduction in sampling and analysis. (shown in TW03 only)</p>
***	<p><i>Technical Basis:</i> This effort is required to ensure that feed is delivered to the RPP WTP in a timely manner with the use of minimum DST space. This activity will seek improved sampling systems that support ALARA goals and can obtain samples that are representative of the waste batch in the tank while the DST mixing system is operating.</p> <p>Other: The Office of Science and Technology, EM-50, has funded the transfer of some non-radioactive demonstrations of the sampling technology using power fluidics during FY 1996 through FY 1999 at Savannah River Site, Oak Ridge, and Idaho Falls. These technologies could</p>

	be integrated with existing analytical techniques in a demonstration relevant to the feed staging applications identified.
19	<i>Cultural/Stakeholder Basis:</i> N/A
20	<i>Environment, Safety, and Health Basis:</i> The sampling system will reduce the exposure of personnel during taking of the samples in the field. It will also reduce the number of samples that must be taken and transferred to the laboratory. A system that can sample while mixing will ensure that representative samples containing a full measure of solid contents are sent to the laboratory for analysis. This will also help in avoiding plugged cross-site transfer lines, and the increased exposure of personnel in taking the necessary actions to clear the plugging
21	<i>Regulatory Drivers:</i> Waste being transferred for treatment and immobilization must be certified as to its contents at some point. This system may be needed to satisfy some part of those requirements including information needed to ensure compliance with the WTP AB. Preliminary discussion with ORP indicate this sampling capability will be an essential part of meeting the newly released <i>Regulatory Data Quality Objectives Supporting Tank Waste Remediation System Privatization Project</i> , Wiemers et. al., PNNL-12040, Rev. 0, December 1998. This document has been approved by both DOE and the regulator, Ecology.
22 *	<i>Milestones:</i> First certification of HLW scheduled for June 2005
23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20) ID-2113 Sludge, Salt, Liquid Risk Score: 3 ID-2857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Double Shell Tanks
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> 12/2004 if needed for first LAW feed certification
29 *	<i>Latest Date Required:</i> 6/2005 based on first HLW feed certification
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Current plans for feed staging tank sampling and analysis involve trying to mix the waste and take a bottle on the string or other grab samples followed by analysis in the 222-S Laboratory. If something more than grab sampling is required, core sampling (both push mode and rotary mode) is available. Neither grab sampling or core sampling can be completed while the tank's mixer pumps are operating and non-representative samples may be taken with the mixer pumps shut down in wastes with high settling rates. It takes weeks or even months to obtain analysis results. Technology Insertion Point: T01-01-108 "Deployment Decision for Selecting Technology for RPP Representative Sampling of Phase I Privatization Feed Staging Tanks", 5/31/2002.
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>

33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> P.J. (Paul) Certa, NHC, 509-376-5429, F/509-376-8652 Paul_J_Certa@rl.gov M.R. (Monica) Kembel, CHG, 509-373-1664, F/509-376-9191, Monica_R_Kembel@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36 **	<i>Other Contacts:</i> R. M. (Mike) Boger, NHC, 509-376-3355, F/509-373-4238, Robert_M_Mike_Boger@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)
2 *	<i>Need Code:</i> RL-WT026
3 *	<i>Need Summary:</i> 67 of Hanford's 149 SSTs are known or suspected to have leaked approximately 1,000,000 gallons of waste into the surrounding vadose zone. All of Hanford's SSTs have exceeded their intended design lives. The use of past-practice sluicing for SST waste removal involves the addition of relatively large volumes of liquid to tanks and therefore increases the potential for waste leakage to the environment. Under Hanford's Federal Facility Agreement and Consent Order (Tri-Party Agreement), leak detection, monitoring, and mitigation systems must be integrated with retrieval system designs. Leak detection currently involves liquid level measurements, material balances between tanks, and dry-well logging. Improvements are needed for current in-tank and ex-tank leak detection methods during tank waste retrieval and transfer operations. Leak detection methods must be capable of detecting tank waste leakage in the vadose zone immediately surrounding the SST's and have the capability to quantify the volume of a leak from a tank. The leak detection techniques must have the capability of interrogating all vadose zone soils surrounding the SST's; even those directly beneath the tank.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No:</i> RL-TW04
9 *	<i>National Priority:</i> <u>X</u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. ___ 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The Retrieval & Disposal Program is responsible for coordinating and integrating Program/Project Planning and Execution; Environment, Safety, Health, and Quality Assurance; Facility Operations; Engineering; Maintenance; Interim Stabilization; and Technology Development, Demonstrations, and Deployments necessary for the safe and cost effective retrieval and disposal of SST and DST wastes, associated underground storage tanks, and ancillary piping and equipment. Safe storage of wastes includes day-to-day operations of the SST's and saltwell pumping operations to remove pumpable liquids from the SST's for transfer to double-shell tanks (DST's) to achieve interim stabilization and minimize the potential for SST leakage. Retrieval projects will be conducted to remove wastes from SST's for placement in DST's in support of waste feed delivery to the Waste Treatment Plant and eventual waste immobilization. An integral part of SST waste retrieval operations is leak detection, monitoring, and mitigation. Safe storage, retrieval, and closure activities associated with SST

	<p>wastes are also supported by Special Projects and Vadose Zone Projects to characterize groundwater flow and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes.</p> <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<p><i>Need/Problem Description:</i> Improvements are needed in both in-tank and ex-tank leak detection methods while wastes are being retrieved and transferred from potentially leaking SSTs. Currently, mass balance calculations have a potential error factor equal to four- to eight-thousand gallons. Furthermore, leaks must migrate to within one meter of existing dry wells before they can be detected with high resolution spectral gamma systems. Given the limits of present leak detection systems, accurate mass balance determinations are essential. Both in-tank and ex-tank leak detection systems that improve on the capabilities of the current baseline approach are needed. The objective is to detect a minimum quantity of liquid escaping the containment of a waste tank in real time so that appropriate monitoring and/or mitigation measures can be implemented. The tank farm areas are congested with underground utilities and pipelines, so instrumentation deployed deep in the ground must take into consideration the difficulty of placing the sensing probes. There are relatively few access ports (tank risers) available for deployment of sensors inside a tank. Leak detection technologies capable of utilizing the existing infrastructure of steel-cased dry wells are desirable.</p> <p>The site geology, although relatively uniform, contains lenses of silt and gravel that can affect the subsurface migration of tank waste leaks. Furthermore, geologic anomalies (e.g., clastic dikes) can exist further complicating the subsurface migration of tank waste leaks.</p> <p>While dry wells extend around the immediate periphery of most SST's to depths ranging from 80 to 130 feet, there are no operating well structures that allow detection directly beneath the tanks to allowing detection of potential leaks moving vertically from the center of the tank. Furthermore, leaks must migrate to within one meter of the dry wells before being detected by current spectral gamma systems.</p> <p>A need exists for tracer, electrical, electromagnetic, seismic, radar, and other techniques capable of leak detection throughout the volume of soil surrounding a tank to enable early, reliable, and accurate leak detection. It is desirable for leak detection technologies to have a 95% probability of detection with no more than a 5% probability of false alarms. It is also desirable for leak detection technologies to be capable of using the existing infrastructure of steel-cased dry wells to minimize deployment costs. Better in-tank leak detection methods are also important and could include spectral gamma detection techniques, pressure transducer technology, and other methods.</p> <p>Consequences of Not Filling Need: A position based upon current baseline detection and mitigation tools and capabilities will be negotiated with Ecology. Provisions for leak detection, monitoring, and mitigation have become an integral part of Tri-Party Agreement milestones</p>

	<p>addressing waste retrieval system designs. Since current capabilities for detection are based primarily on in-tank material balances, the inherent sensing sensitivity is a function of the sensitivity and accuracy of tank liquid level measuring systems. The utility liquid level measuring systems as a means of leak detection become diminished as drainable and pumpable liquids are removed from the tanks through interim stabilization activities. Furthermore, currently envisioned retrieval system designs will introduce little, if any, liquids into the tank in support of waste retrieval operations. Secondary leak detection is currently provided with neutron probe and spectral gamma-ray logging in dry wells surrounding the SST's. However, these techniques are limited to an effective radius of roughly 1 meter around the dry well. Continued efforts to seek new, or enhanced old methods and tools are a major Hanford Stakeholder value that will be associated with approval to proceed. The inability to demonstrate adequate leak detection methods could prohibit the use of some retrieval techniques (especially those that are liquid-based) with resultant impacts to retrieval costs and schedules. Furthermore, improved leak detection methods are required to minimize the volume of contaminants potentially leaked to the vadose zone should a leak occur during retrieval operations. Earlier leak detection provides capabilities for more responsive leak mitigation actions to minimize potential impacts to human health and the environment.</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.01.01.02.02 TIP No.: NA</p>
13	<p><i>Functional Performance Requirements:</i> Volumes involved with SST waste retrieval and transfer must be determined more accurately compared with the present uncertainty of four- to eight-thousand gallons. The final leak detection approach and requirements will be negotiated with DOE-ORP and Ecology and be subjected to the Retrieval Performance Evaluation (RPE) Methodology and applicable Functions and Requirement (F&R) documents. Candidate detection systems will be evaluated by such criteria as overall cost-benefit and risk-reduction potential, ease of use and deployment, overall effectiveness, capability to verify effectiveness, probability of detection, probability of false alarms, and capability to use the existing infrastructure of steel-cased dry wells. Detection systems should address the following types of issues:</p> <ul style="list-style-type: none"> • Sensitivity to detect a minimum leak volume of 2,000 gallons of liquid or less and minimize the time required to detect a leak and provide an indication. • Determine the quantity of leaked material to the value established by the RPE Methodology for each tank/tank farm. • Limit the false detection of a leak to no more than 5% to minimize potential impacts on retrieval operations. • Ensure the probability of detection to be at least 95%. • Use of existing hardware systems and infrastructure to deploy leak detection methods in or around the target tank to required locations that support application in accordance with design and F&Rs. • Availability and/or ability to deploy during the time frame of need (e.g., at the time of a waste retrieval campaign) and during the duration of the retrieval campaign. • Cost-benefit and risk-reduction when compared to the baseline approach and no-action scenario. • The leak detection tool/system must include a capability for installation verification and periodic performance verification while installed and/or in service; including ease of maintenance and operations. • The detection tool/system must utilize materials that are compatible with the waste (i.e., won't degrade), appropriate to the planned period of use, and capable of surviving deployment. • Meet the requirements as documented in the Leak Detection, Monitoring, and Mitigation

	<p>strategy associated with each retrieval technology, the F&Rs, and the RPE Methodology evaluations of retrieval release criteria and target leak detection rates.</p> <ul style="list-style-type: none"> Minimize or preferably eliminate the need to shutdown retrieval operations to make a measurement due to potential concerns over line plugging and other issues affecting tank waste retrieval. <p>Outsourcing Potential: Demonstration of candidate systems and methods will show where other DOE sites, national laboratories, universities, and private industry has the capabilities to perform now and where additional technology development would be helpful. Many possible leak detection techniques are available through the petroleum industry. Furthermore, innovative technology demonstrations focused on tracking the fate and transport of contaminants in the subsurface can also be used in a leak detection mode. Several new leak detection methods have been patented by university and private industry partners, and have potential application to leak detection during tank waste retrieval operations.</p>
**	<p>Schedule Requirements: This need supports Tri-Party Agreement milestones for development and demonstration of waste tank leak detection, monitoring, and mitigation (LDMM) activities and for completing leak detection system design by May 2003 to support design of the SST S-112 saltcake retrieval demonstration design or subsequent tank waste retrieval system designs. Tri-Party Agreement milestones associated with retrieval technology demonstrations under the M45 series milestones require incorporation of LDMM techniques during retrieval system designs and demonstration/evaluation of those tools that prove to be viable. Leak detection systems will be of value throughout the waste retrieval period. Furthermore, if properly designed, leak detection systems may have applicability in support of tank waste closure and post closure monitoring requirements.</p>
14	<p><i>Definition of Solution:</i> The successful solution will have the capability of detecting SST waste leaks on the order of 2,000 gallons or less and provide capabilities to estimate the volume of the tank leak plume in the vadose zone surrounding the SST's. Furthermore, it is highly desirable that leak detection methods be capable of using the existing infrastructure of steel-cased dry wells to minimize deployment costs. Successful leak detection techniques must be "volume integrating" rather than point source measurement methods to enhance capabilities for early leak detection. In-tank leak detection methods must be capable of determining interstitial liquid volumes. It is preferable that in-tank leak detection methods be capable of dynamic rather than static measurements to avoid shutdown of tank waste retrieval operations.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Potential benefits of meeting this need include earlier leak detection to enable timely leak mitigation actions to be implemented thereby minimizing potential impacts to human health and the environment. In addition, by minimizing the leak volume the amount of contaminated soil that must be addressed during site closure activities will be reduced.</p>
17 *	<p><i>Potential Cost Savings:</i> \$200,000,000 to \$500,000,000</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Mitigation of leakage is directly related to the potential extent of action required for tank and tank farm closure, and the implementation of potential closure options. Mitigation and reduction of leakage can, therefore, be directly related to the cost of soil remediation, should that become necessary. A significant cost avoidance is expected if DOE-ORP can avoid this type of higher contingency factor in tank closure and post closure plans. Early and reliable detection of potential tank leaks will minimize the volume of tank leaks before mitigation actions are implemented and help to ensure that retrieval operations conform to health risk based criteria.</p>
**	<p><i>Technical Basis:</i> Provisions for leakage detection are prerequisite to initiating actions to remove waste from leaking or potentially leaking tanks. Tri-Party Agreement M-45 Series Milestones</p>

	require measures for leak detection, monitoring, and mitigation to be included in the design of all SST retrieval systems. Current baseline techniques in use focus on in-tank material balance calculations based on waste level measurements and out-of-tank measurements made in dry wells surrounding the tanks using neutron probes and spectral gamma-ray detectors. The out-of-tank techniques have limited effectiveness due to a relatively small radius of influence around the dry well. Better techniques are needed to detect and quantify tank waste leaks and determine the spatial distribution of the contaminants in the vadose zone directly beneath the tanks. Leak detection systems are being leveraged from past and present efforts conducted through the Subsurface Contamination Focus Area to develop and demonstrate technologies for monitoring plume migration through the vadose zone.
19	<i>Cultural/Stakeholder Basis:</i> Leakage detection and mitigation during waste retrieval are major issues of concern with Ecology and Hanford Stakeholders. This concern is reflected in Tri-Party Agreement milestones, review of the RPP EIS, and in other public documentation.
20	<i>Environment, Safety, and Health Basis:</i> Leakage must not be allowed to occur to an extent that will preclude the use of available tools and methods for remediating the contaminated soil and result in unacceptable human health and environmental risks. The ability to control leakage within risk-based retrieval release criteria established by the RPE Methodology is an important mitigation action to ensure adequate protection of human health and the environment. Better methods for leak detection during waste retrieval will contribute to the capability to ensure that leakage is managed within acceptable limits as established by the RPE Methodology and to maintain overall safe operations during waste retrieval activities.
21	<i>Regulatory Drivers:</i> This task will contribute to the information base that is used during negotiation with Ecology and Hanford Stakeholders regarding a regulatory position for final retrieval and closure of Hanford SSTs. Leak detection, monitoring, and mitigation are major Hanford Stakeholder values and are expressed as a concern by Ecology through the Tri-Party Agreement milestones of the M-45 series. Leak detection, monitoring, and mitigation techniques are being incorporated as part of retrieval system designs per Tri-Party Agreement requirements. Regulations promulgated by Ecology and the EPA require owners and operators of underground storage tank systems to implement leak detection, monitoring, and mitigation as a routine part of tank operations.
22 *	<i>Milestones:</i> T04-03-100, T04-01-341, T04-03-341, T04-04-110, T04-04-120, M-45 Series of TPA milestones
23 *	<i>Material Streams:</i> Sludge, Saltcake, Liquid (RL-HLW-20)
24	<i>TSD System:</i> N/A
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Wastes within the SST tanks and contaminated soils resulting from past tank leaks.
27	<i>Volume/Size of Contaminated Media:</i> Tank volumes range in nominal capacities from 55,000 to 1,000,000 gallons.
28 *	<i>Earliest Date Required:</i> 9/30/01
29 *	<i>Latest Date Required:</i> 5/30/03
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> The current baseline leak detection approach is based on measuring

	<p>the tank liquid level and flowrates of material introduced to a tank for waste retrieval and discharged from the tank as retrieved waste is transferred to the DST system. In addition, high resolution spectral gamma systems are used in dry wells for vadose zone monitoring. Finally, routine groundwater monitoring is conducted to evaluate whether or not leaks have migrated into the groundwater system. A discrepancy among these figures may indicate a leak. The leak sensitivity is estimated to be about 8,000 gallons given current leak detection methods and a variety of uncertainties associated with the methods. Dry well logging is performed in the vadose zone surround the tanks using neutron probes and spectral gamma-ray detectors. The dry well logging tools have limited effectiveness in Hanford soils with radii of detection on the order of a few feet from the wells.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36 **	<i>Other Contacts:</i> J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry_W_Cammann@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Tank Leak Mitigation Systems
2 *	<i>Need Code:</i> RL-WT027
3 *	<p><i>Need Summary:</i> The use of liquid based retrieval methods for SST waste removal involves the addition of liquid to tanks to dislodge, mobilize, retrieve, and transfer the waste and therefore increases the potential for waste leakage to the environment. Leak mitigation applies to all SST retrievals. Leak mitigation efforts and tools, that can be shown to provide cost-benefit and significant risk reduction over baseline methods, must be incorporated into retrieval system design and operating procedures in accordance with the provisions of the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement). Existing mitigation techniques (i.e., the current baseline approach) must continue to be evaluated against potential/candidate mitigating technologies to ensure that the most cost-effective, risk reducing approach is applied. Periodic identification and evaluation of potential leak mitigation tools for possible application during SST retrieval operations is required on a continuing basis. The volume of liquids available for leakage from Hanford's SSTs is being minimized by saltwell pumping operations that are removing drainable and pumpable liquids. Although leak mitigation is being approached proactively through retrieval system designs that use little, if any, liquids to dislodge, mobilize, retrieve, and transfer the waste, a need exists for demonstrating in-tank and ex-tank leak mitigation methods to provide options for deployment should a leak occur to minimize potential impacts on human health and the environment.</p> <p>This leak mitigation need statement is also support by other, more specific, need statements that address the development and demonstration of "getter materials" to reduce contaminant mobility (WT046S) and "reactive barriers to contaminant migration" (WT061).</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval PBS No: RL-TW04
9 *	<p><i>National Priority:</i></p> <p>___X1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>___2. <u>Medium</u> - 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).</p> <p>___3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The Retrieval & Disposal Program is responsible for coordinating and integrating Program/Project Planning and Execution; Environment, Safety, Health, and Quality Assurance; Facility Operations; Engineering; Maintenance; Interim Stabilization; and Technology Development, Demonstrations, and Deployments necessary for the safe and cost effective retrieval and disposal of SST and DST wastes, associated underground storage tanks, and ancillary piping and equipment.</p>

	<p>Safe storage of wastes includes day-to-day operations of the SST's and saltwell pumping operations to remove pumpable liquids from the SST's for transfer to double-shell tanks (DST's) to achieve interim stabilization and minimize the potential for SST leakage. Retrieval projects will be conducted to remove wastes from SST's for placement in DST's in support of waste feed delivery to the Waste Treatment Plant and eventual waste immobilization. An integral part of SST waste retrieval operations is leak detection, monitoring, and mitigation. Safe storage, retrieval, and closure activities associated with SST wastes are also supported by Special Projects and Vadose Zone Projects to characterize groundwater flow and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes.</p>
12	<p><i>Need/Problem Description:</i> Mitigating systems that improve on the capabilities of the current baseline approach are needed. The objective is to prevent, curb, or eliminate the possibility or extent of liquid waste leakage from underground storage tanks into the surrounding soils. If cost-benefit, risk-reduction, and alternatives evaluations of new in-tank and ex-tank mitigating technologies determine that deployment, implementation, and operation is feasible, then further evaluation should be pursued. Such evaluations may include bench- and field-scale demonstrations and testing. Example concepts that could be evaluated include retrieval methods and operating strategies that minimize the potential for leakage, leak point and potential leak point location, seek-and-seal devices and methods, administrative approaches that maximize the use and coordination of currently available tools and methods including such things as sheet pile barriers, close-coupled grout injection barriers, dry-air containment barriers, auxiliary pumping schemes, reactive zones/barriers, "stop-leak" formulations, borehole mining strategies, and other approaches.</p> <p>Consequences of Not Filling Need: A position based upon current baseline mitigation tools and capabilities will be negotiated with Ecology through ongoing efforts to prepare Functions and Requirements (F&R) documents. However, continued effort to seek new, or enhanced old methods and tools is a major Hanford Stakeholder value that will be associated with approval to proceed. Although efforts are being made to minimize the potential for leakage during retrieval operations through retrieval system designs and operating strategies, if a leak does occur, then failure to provide leak mitigation technologies could result in wider spread of contaminants and increased costs to remediate and close the tank farm. Failure to provide effective leak mitigation technologies could increase the risk posed to human health and the environment. Furthermore, if a leak does occur, it is possible that regulators could call for the shutdown of retrieval operations with subsequent impacts on the cost and schedule of retrieval operations.</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.01.01.02.02 TIP No.: NA</p>
13	<p><i>Functional Performance Requirements:</i> The final leak mitigation approach and functional requirements will be negotiated with EOE-ORP and Ecology. Candidate mitigation systems will be evaluated by such criteria as overall cost-benefit and risk-reduction potential, ease of use and deployment, overall effectiveness, and capability to verify effectiveness. Leak mitigation systems should address the following types of issues:</p> <ul style="list-style-type: none"> • Maximizing in-tank and/or ex-tank opportunities to reduce or stop leakage prior to, during, or following waste retrieval. • Use of hardware systems that are deployable in or around the target tank to required locations that will facilitate use as designed. • Availability and/or deployability in order to operate during the time frame of need (e.g., at the time and location of a detected leak, or within the time frame of a waste retrieval campaign) • Cost-benefit and risk-reduction when compared to the baseline approach and no-action

	<p>scenario.</p> <ul style="list-style-type: none"> The mitigation tool/system must include a capability for installation verification and periodic performance verification while installed and/or in service. The mitigation tool/system must utilize materials that are compatible with the waste (i.e., won't degrade), appropriate to the planned period of use, capable of surviving deployment. Should not produce tank or tank waste conditions that preclude further attempts at waste retrieval or tank/tank farm closure, or that create additional, more complex retrieval problems or conditions. In-tank methods must be capable of deploying the leak mitigating provision below the waste level and in such a manner so as to not impact the waste composition adversely when compared to waste feed delivery specifications to the Waste Treatment Plant. Leak mitigation techniques that sequester or otherwise reduce the mobility of contaminants of concern must remain effective over the period of time determined by the Retrieval Performance Evaluation (RPE) Methodology or other appropriate risk-based models. Ex-tank leak mitigation techniques must be deployable in Hanford Site geology in such a manner that a laterally and vertically continuous zone of treatment is achieved. <p>Outsourcing Potential: Demonstration of candidate leak mitigation tools and methods will show where other DOE sites, national laboratories, universities, and private industry has the capabilities to perform now and where additional technology would be helpful. Leak mitigation methods have been developed and deployed in support of the petroleum industry and other industries wherein subsurface hydrogeologic controls are needed. In-tank leak mitigation methods employing non-flowing thixotropic materials have been investigated.</p>
**	<p>Schedule Requirements: This need supports Tri-Party Agreement milestones for development and deployment of waste tank leak detection, monitoring, and mitigation (LDMM) techniques and for completing leak detection, monitoring, and mitigation (LDMM) system design by May 2003. Tri-Party Agreement M-45 series milestones require incorporation of LDMM techniques that will be used during retrieval of SST wastes, and demonstration and evaluation of those tools that prove to be viable. Leak mitigation systems can provide value throughout the duration of waste retrieval. Furthermore, if designed properly, leak mitigation systems can play a prominent role during site closure and post closure operations.</p>
14	<p><i>Definition of Solution:</i> The successful solution will be easily and rapidly deployed either in- or out-of-tank in the event that a leak is detected. The solution will either contain the leakage or mitigate the leakage by reducing the mobility of contaminants of concern (e.g., carbon-14, selenium-79, technetium-99, iodine-129, uranium-238). The successful solution will not adversely impact subsequent efforts directed at tank waste retrieval and will not compromise the composition of waste feed to the Waste Treatment Plant. The successful solution must sequester or otherwise immobilize contaminants of concern over a time period to be determined by the RPE Methodology or other risk-based approach.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i></p>
17 *	<p><i>Potential Cost Savings:</i> \$200,000,000 to \$500,000,000</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Mitigation of leakage is directly related to the potential extent of action required for tank and tank farm remediation and closure, and the implementation of potential closure options. Mitigation and reduction of leakage can, therefore, be directly related to the cost of soil remediation should that become necessary. A significant cost avoidance is</p>

	expected if DOE can avoid this type of higher contingency factor. Successful leak mitigation techniques will allow consideration of a greater range of waste retrieval options and methods and minimize the need for retrieval system shutdown with impacts to cost and schedule.
18*	<i>Technical Basis:</i> Provisions for leakage mitigation are critical to initiating actions to remove waste from leaking tanks. Tri-Party Agreement M-45 Series Milestones require measures for leak detection, monitoring, and mitigation to be included in the design of all SST retrieval systems. At present, if a leak is detected during waste retrieval operations the only option is to increase the waste pumping rate (e.g., through auxiliary pumping) to minimize the potential impact of the leak. Capabilities to implement in-tank stop leak methods and/or subsurface barriers and reactive zone to tank leaks should be investigated as part of a comprehensive approach to successful leak mitigation during retrieval operations. Bench-scale testing of reactive zones has demonstrated “proof of concept” for immobilizing contaminants such as technetium, uranium, and actinides.
19	<i>Cultural/Stakeholder Basis:</i> Leak detection, monitoring, and mitigation (LDMM) during waste retrieval are major issues of concern with Ecology and Hanford Stakeholders. This concern is reflected in Tri-Party Agreement milestones, review of the RPP EIS, and in other public documentation. Recent Tri-Party Agreement negotiations has resulted in the integration of LDMM provisions with retrieval system designs.
20	<i>Environment, Safety, and Health Basis:</i> Leakage must not be allowed to occur to an extent that will preclude the use of available tools and methods for remediating the contaminated soil or result in unacceptable environmental risks as determined by the RPE Methodology or other risk-based approach. A viable approach to leak mitigation during waste retrieval operations will contribute to the capability to ensure that leakage is managed within retrieval release criteria and target leak detection rates as determined by the risk-based RPE Methodology, and to maintain overall safe operations during waste retrieval. Demonstrated capabilities for leak mitigation during tank waste retrieval operations will help to ensure adequate protection of human health and the environment should a leak occur.
21	<i>Regulatory Drivers:</i> This task will contribute to the information base that is used during negotiation with Ecology and Hanford Stakeholders regarding a regulatory position for final retrieval and closure of Hanford SSTs. Leak mitigation is a major Hanford Stakeholder value and is expressed as a concern by Ecology through the Tri-Party Agreement M-45 series milestones. Regulations applicable to owners and operators of underground storage tanks require implementation of leak mitigation measures.
22 *	<i>Milestones:</i> T04-01-341, T04-02-341, T04-03-100, T04-03-341, T04-04-110, T04-04-120, M-45 Tri-Party Agreement milestones.
23 *	<i>Material Streams:</i> Sludge, Saltcake, Liquid (RL-HLW-20)
24	<i>TSD System:</i> N/A
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank wastes and vadose zone soils.
27	<i>Volume/Size of Contaminated Media:</i> Nominal capacities of SSTs range from 55,000 to 1,000,000 gallons.
28 *	<i>Earliest Date Required:</i> 9/30/01
29 *	<i>Latest Date Required:</i> 9/30/03
Baseline Technology Information	

30	<p><i>Baseline Technology/Process:</i> Current baseline mitigation approach includes the following measures:</p> <ul style="list-style-type: none"> • Use of smart waste retrieval methods and operating procedures to minimize aggravation of tank weak points. • Retrieving waste with appropriate diligence to determine, at the earliest possible time, if leakage is occurring. • Removal of drainable and pumpable liquids from tanks via interim stabilization saltwell pumping operations . • Minimization of operational/system down-time during which leaks can proceed by providing availability of [backup] equipment and staff. • Designing retrieval systems and equipment for dependability and minimum maintenance using little, if any, liquids to dislodge, mobilize, retrieve, and transfer wastes into the DST system. <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry W Cammann@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov</p>
36 **	<p><i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Monitoring of Key Waste Physical Properties During Retrieval and Transport
2 *	<i>Need Code:</i> RL-WT032
3 *	<p><i>Need Summary:</i> Monitoring of key waste physical properties during retrieval and transport of the material between tanks and to the waste treatment plant is needed to meet the contractual physical property requirements for low-activity waste feed and high-level waste feed.</p> <p>Control of insoluble solids is necessary for low-activity waste deliveries to the waste treatment plant to limit the solid material transferred to less than 2 weight percent (dry basis) to meet contractual requirements.</p> <p>For high-level waste deliveries to the waste treatment plant it is contractually required to transfer waste with between 10 and 200 grams of unwashed solids per liter of waste.</p> <p>Measurement of real-time solids concentration near the transfer pump inlet or in the transfer pipeline can be a key process control parameter during low-activity waste supernate deliveries (used to determine the effectiveness of the settle-decant step) and high-level waste slurry deliveries (used to determine if the slurry concentration is within range and the mass of solids in the feed batch).</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No.:</i> RL-TW04
9 *	<p><i>National Priority:</i></p> <p>☐ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>☒ 2. <u>Medium</u> - 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).</p> <p>☐ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> Double Shell Tank (DST) and Waste Feed Delivery project maintains, operates and upgrades the DST System for continued safe storage and receipt of radioactive waste. Activities include transferring waste to waste treatment facilities, maintaining and evaluating operating and surveillance systems necessary for compliance with regulatory and AA/AB requirements, identifying if systems are reliable for this mission, transferring waste within the DSTs to manage the limited available space; characterizing waste to understand its properties, and developing flow sheets for waste treatment.</p> <p>The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function</p>

	<p>is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms.
12	<p><i>Need/Problem Description:</i> The waste treatment process (vitrification) requires low-activity waste be delivered with no greater than 2 wt% solids (dry basis). High-level waste must be delivered at between 10 and 200 grams solids per liter, which equates to a lower limit of approximately 1-wt% solids. In either case it is desirous to know the in-situ solids content of the material being transferred to the treatment facility for the purposes of meeting the contractual requirements and for process control of the transfer.</p> <p>Any in-tank solids concentration instrumentation would have to withstand forces from operating equipment, primarily two, 300-hp mixer pumps, while measuring solids concentration.</p> <p>Consequences Of Not Filling Need: Failure to accurately detect deviations in the solids content may result in delivering material out of specification resulting in process delays and increased cost. Additionally, delivery of undersized high-level waste feed batches will increase the number of HLW transfers required to keep the plant running.</p> <p>***</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.02.01.02 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> A method to accurately in-situ (either in-tank or in-pipe) measure solids concentration at both low concentrations (e.g. 1-5 wt%) and high concentrations (10-200 gram per liter) is needed. In-tank systems would need to withstand and operate under the forces generated from mixer pump operation.</p> <p>Outsourcing Potential: Solids concentration measurement could be applicable to other DOE and private industry cleanup sites.</p>
***	<p><i>Schedule Requirements:</i> Deployment of functional systems for solids content as soon as possible will minimize the cost impacts due to changes in the existing baseline the retrieval system design.</p>
14	<p><i>Definition of Solution:</i></p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i></p>
17 *	<p><i>Potential Cost Savings:</i> \$20,000,000</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Deployment of in-situ solids concentration instrumentation could provide cost savings for the delivery of the waste feed to the treatment plant by increasing total operating efficiency by avoiding delivery of waste feed outside specification requirements, or inadvertent delivery of undersized HLW feed batches.</p>
***	<p><i>Technical Basis:</i> RPP Privatization Contract Number DE-AC06-96RL13308 specifies feed and product requirements.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> N/A</p>
20	<p><i>Environment, Safety, and Health Basis:</i> N/A</p>

21	<i>Regulatory Drivers:</i> N/A
22 *	<i>Milestones:</i>
23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20) ID-2113 Sludge, Salt, Liquid Risk Score: 3 ID-2857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Double Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> All double shell tanks are 75 feet in diameter, and about 40 feet deep, deep with their tops buried about 10 feet below the ground surface.
28 *	<i>Earliest Date Required:</i> Fiscal Year 2002
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> <i>Technology Insertion Point(s):</i>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> Paul J. Certa, CHG, 509-376-5429, Paul_J_Certa@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36 **	<i>Other Contacts:</i> J.G. (John) Kristofzski, CHG, 509-373-4225, F/509-372-1664, John_G_Kristofzski@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Mixer Mobilization Pump Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)
2 *	<i>Need Code:</i> RL-WT054
3 *	<i>Need Summary:</i> Validated correlations or computational fluid dynamic models that can be used to predict the performance of mixer pumps as a function of definable waste properties and system configuration. The key performance measures of interest are the effective cleaning radius, time-varying vertical solids concentration profile, and most importantly, the amount of waste actually retrievable from the tank.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval PBS No.: ORP-TW04
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms.
12	<i>Need/Problem Description:</i> The basic need is to be able to predict the performance of mixer-pumps planned for deployment in DSTs at Hanford, based on physical properties of the waste, the mixer pump design parameters, and the overall configuration of the system (such as sludge depth, supernate depth, vertical and horizontal location of mixer pump discharge nozzles). This need was previously focused on accurate measurement of shear strength because of the perceived importance of shear strength to the ECR of a mixer pump. However, all of PNNL's mixer pump test data were recently correlated with three dimensionless parameters (Letter Report by Shekarritz et al. April 1998) with the following result: ECR is much more sensitive to nozzle velocity ($U_o^{0.75}$) than to shear strength ($1/\tau_s^{0.17}$). Shear strength appears to be less important than the characteristics of the jet.

	<p>In full-scale mixer pumps, pumped slurry exits through a very short nozzle that may not create a well-developed jet, while small-scale mobilization tests used a nozzle that created a well-developed jet. It isn't clear if the current mixer pump design produces jets that are analogous to the small-scale tests, and consequently, the validity of using the correlations to predict full-scale performance is in question.</p> <p>Recent computational fluid dynamic modeling completed for tank AZ-102 (PNNL-13275) predicts that only 50% of the sludge present in that tank will be mobilized by operating two, 300-hp mixer pumps according to current baseline plans. This is significantly less than the currently planned retrieval efficiency of 80% (HNF-SD-WM-SP-012, Rev. 2, p. 4-2). The 80% retrieval efficiency is based on the best available ECR correlation.</p> <p>In FY 2000, a process test of the two, 300-hp mixer pumps in AZ-101 (RPP-6548 Rev 1) found that 95-100% of the waste was <u>mobilized</u>, however, an accurate unbiased estimate of the amount of waste <u>suspended</u> (and therefore the retrieval efficiency) could not be accurately determined. The planned retrieval efficiency for AZ-101 was 90%. "Based on grab sample analysis, augmented with estimates of solid concentration for regions of the tank where grab sample data were not available, the weight percent of sludge suspended by operation of two mixer pumps at maximum speed is 41 percent. Additional calculations using data from both grab samples and the gamma probe estimate that approximately 38 percent of the sludge was suspended. The remaining 59 to 62 percent of the mass either was partially suspended or pushed along the bottom of the tank. A higher concentration of solids in grab samples near the bottom of the tank, and a sharp increase in the gamma-probe reading due to radionuclides in the solid phase, suggests that the solids do not become uniformly suspended throughout the tank but some portions of the solids are suspended at a much smaller height relative to the overall height of the waste. Interpretation of the data was complicated by the fast settling nature of the sludge, the difference between the shutoff time of the two mixer pumps at the end of the test, and the fact that no grab samples or instrument readings (other than temperature) could be taken under the conditions of interest – while both mixer pumps were running. An accurate, unbiased estimate of the amount of sludge actually suspended could not be determined."</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.02.01.04 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> Mixer pump performance correlations and computational fluid dynamic modeling (TEMPEST) need to predict the performance of the actual pump design deployed under actual tank waste retrieval conditions (i.e., actual tank demonstrations). Correlations and models should consider current mobilization and pump data from Hanford, Savannah River Site and any other sites and allow designers to successfully address required mobilization, suspension, and retrieval efficiency performance. Increasing the accuracy of the predictions also requires reliable physical property information for the waste being retrieved.</p> <p>More accurate predictions of mixer pump performance would reduce the uncertainty with mixer pump performance. If mixer pumps are not as efficient at <u>retrieving</u> the waste as anticipated, alternative or supplemental approaches to retrieval may need to be pursued. These alternatives could include supplemental mixing, additional feed tanks, or modifying pump design needs and retrieval strategies to be consistent with actual sludge mobilization performance.</p> <p>Project W-211 has numerous scale model tests and theoretical analysis on which to base the mixer</p>

	<p>pump design. Further lab work does not seem prudent. The Pacific Northwest National Laboratory (PNNL) report referenced above (i.e., Letter Report by Shekarriz et al. April 1998), which was funded by Project W-211, did conclude differently than previous effective cleaning radius (ECR) correlations. However, it did not conclude that the pumps currently in the project are inadequate. Validation of the ECR correlation's and computational fluid dynamic models (TEMPEST) should use the results from the Tank AZ-101 mixer pump process test (RPP-6548 Rev 1)</p> <p>Confidence in the results of the computational fluid dynamic model (TEMPEST) could be increased by seeing if the model can predict the results of the AZ-101 mixer pump test as documented in RPP-6548 Rev 1 with respect to mobilization, suspension, and settling. With appropriate input data, the model could then be used to predict the performance of mixer pumps in other high-level waste tanks. A better understanding of conditions (primarily the time varying solids concentration field) inside the tanks during and after mixer pump operation is required to refine the retrieval strategy and to estimate retrieval efficiency.</p> <p>Outsourcing Potential: DOE complex only.</p>																		
***	<p>Schedule Requirements: This needs to be resolved so it can influence design updates to the high-level waste tanks. Key dates for the various high-level waste tanks are as follows:</p> <table><tr><td>Tank</td><td>Start of Design</td><td>Start of Construction</td></tr><tr><td>AZ-101</td><td>FY2001</td><td>FY2002</td></tr><tr><td>AZ-102</td><td>FY1999</td><td>FY2005</td></tr><tr><td>AY-102</td><td>FY2001</td><td>FY2006</td></tr><tr><td>AY-101</td><td>FY2001</td><td>FY2008</td></tr><tr><td>SY-102</td><td>FY2007</td><td>FY2010 (Project W-521)</td></tr></table> <p>Early results (i.e., a validated model) will allow for better management of the programmatic risks with respect to the quantity of HLW feed that can be delivered to the Waste Treatment Plant.</p>	Tank	Start of Design	Start of Construction	AZ-101	FY2001	FY2002	AZ-102	FY1999	FY2005	AY-102	FY2001	FY2006	AY-101	FY2001	FY2008	SY-102	FY2007	FY2010 (Project W-521)
Tank	Start of Design	Start of Construction																	
AZ-101	FY2001	FY2002																	
AZ-102	FY1999	FY2005																	
AY-102	FY2001	FY2006																	
AY-101	FY2001	FY2008																	
SY-102	FY2007	FY2010 (Project W-521)																	
14	<i>Definition of Solution:</i>																		
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)																		
16	<p><i>Potential Benefits:</i> There is considerable uncertainty in the planning assumptions used to set the timing of the construction projects that provide the mixing and retrieval systems for delivery of HLW slurry feed to the Waste Treatment Plant. A more accurate estimate of the amount of feed that can be retrieved and delivered from each tank will allow for refinements in the project schedules. Schedule float may be identified and freed up for other uses in instances in which the planning assumptions turn out to be pessimistic. On the other hand, early mitigating actions (such as more mixers, acceleration of project schedules, identification of backup feed sources) can be taken in instances in which the planning assumptions turn out to be optimistic.</p> <p>Understanding the time-varying solids concentration profiles will help refine the estimates of the amount of feed that can be delivered (discussed above) and ensure that an effective process control strategy for the mobilization, suspension, and delivery of feed to the Waste Treatment Plant can be implemented with the current retrieval system designs.</p>																		
17 *	<i>Potential Cost Savings:</i> Up to \$100M in cost avoidance.																		
18 *	<p><i>Potential Cost Savings Narrative:</i> This is a risk (potential loss x probability) mitigating activity. The size of the potential loss is large if the retrieval efficiencies of the high-level waste tanks are significantly less than planned. The potential loss could be as large as the \$100M in capital costs associated with the retrieval system projects if major rework is required plus the schedule and financial impacts of delaying high-level waste vitrification at the Waste Treatment Plan. On the</p>																		

	other hand, some moderate cost savings may be realized if there is design conservatism that can be reduced for future pump installations.
**	<p><i>Technical Basis:</i> Current equations for calculating mobilization efficiency have never been validated for actual conditions during full-scale retrieval. Additionally, correlations or model results for solids suspension, and to some degree settling, are not available. Timing of construction projects requires an accurate estimate of the amount of waste that can be retrieved from each tank and delivered to the Waste Treatment Plant. This timing is currently based on an unvalidated ECR correlation, which neglects solids suspension and settling behavior. Solids suspension and settling data is required to ensure that the retrieval and process control strategies will be effective.</p> <p>Other: Remove uncertainty pertaining to DOE's readiness to deliver the required volume of feed to the Waste Treatment Plant.</p>
19	<i>Cultural/Stakeholder Basis:</i> N/A
20	<i>Environment, Safety, and Health Basis:</i> N/A
21	<i>Regulatory Drivers:</i> N/A
22 *	<i>Milestones:</i> This activity supports the objective of treating 10% of the Hanford tank waste by mass and 25% by curies by 2018.
23 *	<p><i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20)</p> <p>ID-2113 Sludge, Salt, Liquid Risk Score: 3</p> <p>ID-2857 HLW to Treatment Risk Score: 3</p>
24	<i>TSD System:</i> Double Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> Fiscal Year 2002
29 *	<i>Latest Date Required:</i> September 2005
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> Correlations derived from small-scale mobilization testing and a computational fluid dynamic model (TEMPEST), neither of which has been compared to full-scale tests.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i></p> <p>P.J. (Paul) Certa, NHC, 509-376-5429, Paul_J_Certa@rl.gov</p>
35	<i>DOE End User POCs:</i>

	E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov
36 *	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-371-3607, F/509-371-3504, Kenneth A Ken Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Hanford/SRS Waste Mixing Mobilization
2 *	<i>Need Code:</i> RL-WT060
3 *	<i>Need Summary:</i> 1) Hanford is considering, from a risk mitigation standpoint, enhanced sludge mobilization methods to retrieve sludge that is beyond the Effective Cleaning Radius (ECR) of the baseline pair of long-shaft mixer pumps. The objective is a small system that can be installed in the tanks along with the mixers when needed to mobilize the remaining sludge. 2) Both Hanford and SRS are also interested in identifying replacements for baseline mixer pumps with more cost-effective alternates with respect to life-cycle/operations costs for bulk sludge, sludge heel, and salt cake retrieval both in large HLW storage tanks and in smaller process tanks such as SRS transfer system Pump Tanks. 3) Hanford would like mixer pumps that can be started under several feet of sludge or settled salts in a straightforward manner. 4) Hanford would like mixer pumps that can minimize or remove the pumping energy added to the tank to reduce waste heating (i.e., provide cooling).
4 *	<i>Origination Date :</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval PBS No.: ORP-TW04
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms.
12	<i>Need/Problem Description:</i> Mixer pumps are the current baseline technology for retrieval of waste from DSTs. The pumps are used to mobilize and suspend sludge in HLW tanks to allow pumping the resulting slurry to another DST or the waste treatment plant. The mixer pumps are also used to

	<p>dissolve settled salts in LAW tanks by mixing them with water to allow pumping the supernate to another DST or the waste treatment plant. The pumps may also be used for the blending of slurries and/or supernates to reduce variability in the feed delivered to the waste treatment plant.</p> <p>Mixer pump technology is expensive, and has only been partially demonstrated in Hanford Tanks (for the mitigation of the flammable gas issue in tank 241-SY-101 and during the mixer pump process test conducted in tank 241-AZ-101). Because of the expense of and the limited experience base with mixer pumps at Hanford, it is desirable to continue looking for alternatives or enhancements, which are more effective, provide additional flexibility, and/or cost less.</p> <p>The existing mixer pumps, when run at full power for extended periods of time, can heat the waste faster than permitted by operating specifications. If cooling capability were provided, process control would be more straightforward and flexible because the pump power and operating time could be selected based on waste mobilization requirements rather than waste temperature changes.</p> <p>The current generation of mixer pumps has long shafts with either gas or water filled bearing columns, with seals at the top and bottom of the column. These pumps are prone to shaft alignment problems, seal failures, vibration, etc. Plus the bearing column represents a pathway from the contaminated zone to the non-contaminated environment. A new generation mixer pump or alternative mixing system is needed to offset these problems areas.</p> <p>Consequences of Not Filling Need: One of the principal goals of this effort is to manage the performance risks of the mixer pumps. Pumps have been extensively tested with simulants both in scale and full size. Full-scale in-situ experience at Hanford is so far limited to the AZ-101 mixer pump test recently completed. While the results of the test are encouraging they do not constitute a comprehensive performance demonstration, as this specific tank is not a representative and challenging case (low sludge shear strength, small amount of sludge, etc...). There is also some risk that the Hanford waste will behave significantly differently than the simulants, and so the mixer pump performance may be different than predicted.</p> <p>*** Hanford and Savannah River have been cooperating with TFA to both improve the current mixer pump design and identify suitable alternative technologies. This effort needs to continue (especially regarding emerging SRS mixer pump technology data).</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.02.01.04 TIP No.: N/A</p>															
13	<p><i>Functional Performance Requirements:</i> As a baseline replacement, (Need #2 above), the mixer pump must mobilize and mix the waste to retrieve as much waste as is reasonably possible from each source tank. The following table summarizes the current baseline mixer pump and the Advanced Design Mixer Pump performance parameters and costs. The alternatives or enhancements must compete against these if they are to produce improvements.</p> <table><tr><th><u>Parameter</u></th><th><u>Baseline Mixer Pump (Project W-211)</u></th><th><u>Advanced Design</u></th></tr><tr><td><u>Mixer Pump</u></td><td></td><td></td></tr><tr><td>Cost for each pump</td><td>\$500K</td><td>\$625K</td></tr><tr><td>U_oD (nozzle velocity X nozzle diameter) ft²/sec</td><td>29.4</td><td>29.4</td></tr><tr><td>Riser diameter (inches)</td><td>42</td><td>42</td></tr></table>	<u>Parameter</u>	<u>Baseline Mixer Pump (Project W-211)</u>	<u>Advanced Design</u>	<u>Mixer Pump</u>			Cost for each pump	\$500K	\$625K	U _o D (nozzle velocity X nozzle diameter) ft ² /sec	29.4	29.4	Riser diameter (inches)	42	42
<u>Parameter</u>	<u>Baseline Mixer Pump (Project W-211)</u>	<u>Advanced Design</u>														
<u>Mixer Pump</u>																
Cost for each pump	\$500K	\$625K														
U _o D (nozzle velocity X nozzle diameter) ft ² /sec	29.4	29.4														
Riser diameter (inches)	42	42														

	<p>Installed Weight (lbs) 25,000 20,000</p> <p>Pump operating life, intermittent (hrs) 5,000 5,000</p> <p>Pump starts/stops 100 100</p> <p>Pump installed life in tank (years) 5 10</p> <p>Approximate total quantity of pumps required for the RPP program life 216 86</p> <p>For <i>Need #3</i>, Hanford would like mixer pumps that can be started under several feet of sludge or settled salts. Hanford has not yet demonstrated that a mixer pump can be started and operated under several feet of sludge or settled salts. Baseline plans assume that the pump will startup after addition of flush water (this is complicated because the current mixer pump can not be operated at speeds of less than 700 rpm with damaging the pump); in the event that this approach does not work, the current risk handling action is to use a jack-screw assembly to incrementally lower the mixer pump into the waste. A mixer pump design that lends itself to a more straightforward method of start-up would significantly reduce the programmatic risk.</p> <p>For <i>Need #4</i>, Hanford would like mixer pumps fitted with a cooling system to extract the pumping energy to avoid heating the waste, this cooling system must be at least able to remove the maximum horsepower the pump driver can deliver. The existing mixer pumps, when run at full power for extended periods of time, can heat the waste faster than permitted by operating specifications. If cooling capability were provided, process control would be more straightforward and flexible because the pump power and operating time could be selected based on waste mobilization requirements rather than waste temperature changes.</p>
	<p>*** Schedule Requirements: The first waste feed delivery to the waste treatment facility will rely on mixer pumps to mobilize the waste, and is scheduled for completion of turnover to operations in 2005.</p> <p>Two pumps were installed in 101-AZ by project W-151 to run process tests. Project W-151 has procured a spare pump. Project W-211 has procured two pumps for installation in other DSTs. Alternatives to mixer pump technology which are more cost effective can only be considered if they are developed before the W-211 project has more mixer pumps fabricated, which will and continue each year for several years.</p> <p>Therefore, this effort should be completed soon to achieve maximum performance improvement, risk reduction, and/or cost reduction, while generating the minimum disruption to W-211 plans and design efforts.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$20,000,000
18 *	<i>Potential Cost Savings Narrative:</i> The baseline cost for the current mixer pumps is \$500K per pump. The advanced design mixer pump is expected to cost \$625K per pump in production quantities. (There are actually even larger costs connected to infrastructure upgrades and support systems required by the mixer pumps; a fair comparison with an alternative technology needs to account for these costs). Therefore, any alternative technology must be cost competitive with this

	<p>mixer pump to be used. Two mixer pumps are generally planned for deployment in Hanford DSTs, with a total of 50 pumps currently planned (not all DSTs will receive mixer pumps). Over the life of the RPP program about 216 of the baseline pumps will be needed. If the advanced design mixer pump replaces the baseline pump, that quantity drops to about 86 pumps. Therefore, the current baseline will spend \$108M for the baseline pump or \$53.8M for the Advanced Design Mixer Pump. These costs are embedded in already authorized capital projects totaling over \$500 million. To be cost effective alternatives must reduce this overall cost.</p>
**	<p><i>Technical Basis:</i> There are programmatic risks concerning the effectiveness of the existing mixer pump design to a) mobilize and suspend solids to the degree assumed in planning documentation, b) to be able to startup the pumps in a straightforward manner, c) overall reliability, and d) possible restrictions in pump power or operating time in order to satisfy tank waste temperature rate-of-change limits. Some of these concerns are discussed in "Test Report, 241-AZ-101 Mixer Pump Test", RPP-6548, Revision 1.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> None expressed by STCG Tanks Subgroup.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> Improvements to mixer pump performance will reduce the amount of residual waste remaining in the DST when ready for closure in the future. This will reduce operator exposure when doing final clean out.</p>
21	<p><i>Regulatory Drivers:</i> A failure to deliver required quantities of feed to the WTP will delay treatment, and may impact the ability to meet the RPP program commitments.</p>
22 *	<p><i>Milestones:</i> Waste feed delivery milestones (2005 and onwards)</p>
23 *	<p><i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20) ID-2113 Sludge, Salt, Liquid Risk Score: 3 ID-2857 HLW to Treatment Risk Score: 3</p>
24	<p><i>TSD System:</i> Double Shell Tank systems ID-1722 Underground Storage Tanks Risk Score: 1</p>
25	<p><i>Major Contaminants:</i> 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)</p>
26	<p><i>Contaminated Media:</i> Dominantly steel</p>
27	<p><i>Volume/Size of Contaminated Media:</i> Long length equipment</p>
28 *	<p><i>Earliest Date Required:</i> September 2002</p>
29 *	<p><i>Latest Date Required:</i> September 2005</p>
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> The current baseline technology is the use of "Project W-211 style" mixer pumps.</p> <p>Technology Insertion Point(s): N/A</p>
31	<p><i>Life-Cycle Cost Using Baseline:</i></p>
32	<p><i>Uncertainty on Baseline Life-Cycle Cost:</i></p>
33	<p><i>Completion Date Using Baseline:</i> 2018</p>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> P.J. (Paul) Certa, NHC, 509-376-5429, F/509-376-8652 Paul_J_Certa@rl.gov</p>

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35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov
36 **	<i>Other Contacts:</i> R. W. (Ron) Reed, CHG, 509-373-5546, Ronald W Ron Reed@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Variable Suction Level Transfer Pump
2 *	<i>Need Code:</i> RL-WT062
3 *	<i>Need Summary:</i> A transfer pump that can draw waste from pre-selected levels that range from the surface to within 10" or less of the tank bottom, and can be operated simultaneously with mixer pumps. The current baseline transfer pump achieves variable suction levels by using a flexible hose controlled by a tether cable. This design can't be operated simultaneously with mixer pumps because of hose instability and may be difficult to lower in viscous waste. Baseline transfer pumps that can be operated simultaneously with mixer pumps do not have variable suction level.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval PBS No.: ORP-TW04
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms.
12	<i>Need/Problem Description:</i> The current design does not allow for simultaneous operations of the variable suction level transfer pump while the mixer pumps are operating. Only fixed suction level transfer pumps can be operated simultaneously with mixer pumps. The current baseline equips sludge tanks (HLW feed to the treatment plant) with fixed suction level transfer pumps, in order to allow solids suspension by mixer pump during transfers. However, some HLW tanks will need decanting capabilities for both the baseline process, and risk mitigation-type activities, such as contingency staging space for LAW feed. The current design equips the salt tanks (LAW feed to the treatment plant) with variable suction level transfer pumps, in order to enable decanting of the supernate and delivery of solid free LAW

	<p>to the treatment plant, as required by the feed specification. The current design for these pumps (flexible hose) does not allow simultaneous mixer pump operation. However, these tanks may also require simultaneous mixer pump and transfer pump operation for specific situations, such as solids accumulation mitigation, or contingency space for HLW staging.</p> <p>A transfer pump that can draw waste from pre-selected levels that range from the surface to within 10" or less of the tank bottom, and can be operated simultaneously with mixer pumps is needed.</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.02.01.04 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i></p> <p>Conclusions from a demonstration must confirm these capabilities:</p> <ul style="list-style-type: none"> • Pump 160 gpm @ approximately 880 ft head with SpG = 1.5 and viscosity of 30 cP • Withstand lateral forces from mixer pumps of up to 500 lb while operating • Operate in highly caustic waste (approx. 5% NaOH) • Pump liquid up to 200°F. • Variable suction level
**	<p><i>Schedule Requirements:</i> The results of this activity must be completed to provide design criteria and guidance to projects W-21 and W-521 to support feed delivery of LAW and HLW to the waste treatment plant. Based on the design requirements, the method selected may be able to be adapted to already complete designs. The demonstration should be completed no later than FY 2002 to generate the greatest benefit.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tank Focus Area (TFA)
16	<i>Potential Benefits:</i> Higher waste recovery
17 *	<i>Potential Cost Savings:</i> \$200,000,000
18 *	<p><i>Potential Cost Savings Narrative:</i> A potentially significant risk (unplanned cost) may be avoided if transfer pumps can be operated concurrently with mixer pumps. This unplanned cost would come from need for contingency staging space, or out-of-spec waste transfers that require additional time, analysis, tank transfers and potentially treatment delays. Each out-of-specification event could have cost impacts up to \$100K or more.</p>
**	<p><i>Technical Basis:</i> Waste properties and process baseline show the need for both variable suction level transfer and simultaneous mixer/transfer pump operations in the same tank. This need statement is linked to WT-060, Hanford/SRS Waste Mixing Mobilization.</p>
19	<i>Cultural/Stakeholder Basis:</i> N/A
20	<i>Environment, Safety, and Health Basis:</i> There are no identified environmental, safety or health issues associated with this activity over those already identified as part of the project.
21	<i>Regulatory Drivers:</i> There are no identified regulatory issues associated with this activity over those already identified as part of the project.
22 *	<i>Milestones:</i> Waste feed delivery milestones (2005 and onwards)
23 *	<p><i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20) ID-3857 HLW to Treatment Risk Score: 3</p>
24	<i>TSD System:</i> Double Shell Tank systems

	ID-1722 Underground Storage Tanks Risk Score: 1
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Dominantly steel.
27	<i>Volume/Size of Contaminated Media:</i> Long length equipment.
28 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> September 2009
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> Baseline technology is a line shaft pump modified with a flexible hose attached to the pump inlet. The flexible hose nozzle is raised and lowered using a hoist with cable attached to the nozzle. The pump cannot be operated while the mixer pumps are operated due the flexible hose not being able to withstand the forces. The flexible hose can be raised and lowered to allow waste to be decanted at any elevation.</p> <p><i>Costs:</i> Current baseline transfer pump cost is \$385,000 including the drive motor and variable frequency drive (VFD).</p> <p><i>Technology Insertion Point(s):</i> N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i> 2018
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> C. E. (Carolyn) Graves, NHC, 509-376-5235, Carolyn E Cary Graves@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov</p>
36 **	<p><i>Other Contacts:</i> W. J. (Bill) Powell, CHG, 509-373-1072, William_J_Bill_Powell@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Hanford Single Shell Tank (SST) Saltcake Dissolution Retrieval
2 *	<i>Need Code:</i> RL-WT063
3 *	<i>Need Summary:</i> Performance data and retrieval efficiency data are required for a simplified sprinkler-applied (low volume) water dissolution of saltcake system for use in Hanford's single-shell tanks (SSTs). Effects of in-tank hardware and tank walls shall also be determined. This system is also known as the Low Volume Density Gradient (LVDG) retrieval method. Application of this method to a representative simulant of waste shall provide the necessary data to select this method for baseline implementation.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No:</i> ORP-TW04
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<i>Need/Problem Description:</i> A significantly less costly system is desired for SST saltcake waste retrieval. The current SST baseline cost is \$ 120 Million per tank or higher using the past practice sluicing method. The saltcake dissolution method can potentially use much of the existing transfer lines and infrastructure. By placement of a single or multiple sprinkler system through a riser into a SST, water can be added to the tank gradually to allow the saltcake to dissolve. As the dissolution proceeds, existing transfer pumps may be capable of transferring the solution out of the tank to a feed staging tank. This would appear to be a significantly cheaper and less complex system than past practice

sluicing for saltcake retrieval.

A demonstration of this sprinkler system will be performed in tank 241-S-112 starting in FY-02. However, this demonstration will not answer all questions relating to this method. There are questions in waste chemistry, application methods, cycle time, retrieval strategy, etc that will not be fully answered by this test.

Many of the waste chemistry needs are addressed under RL-WT091, *Chemical and Physical Behavior of Saltcake Wastes*. The fate of the hydroxide is another concern. The concept as developed today would add water to the waste and allow salt cake to dissolve. The brine would slowly be removed and replaced by water. This effectively removes the chemicals that are present in the interstitial liquor. Hydroxide is essentially totally soluble. The removal of hydroxide may allow aluminum to precipitate or not dissolve. The hydroxide may be washed out first and latter brines may not be within corrosion specifications to allow the brines to be received into double shell tanks. Hydroxide may also be important in solubility of other species besides aluminum. This may mean that some of the early brine may need to be recycled just for hydroxide control or additional hydroxide may need to be added with the water.

Even though the intent is to evenly add water to the saltcake, it should be anticipated that gullies will eventually erode in the surface of the waste. How the gullies will affect the efficiency of the waste is not fully understood. They may be beneficial and assist in liquid transfer to the retrieval pump or they may not allow the water to become fully saturated.

Indications from tests done to date in the laboratory are that the highly soluble salts such as sodium nitrate may be dissolved and removed first. The brine may be high density (>1.35 SpG) at this time. Eventually, the sparingly soluble solids such as sodium carbonate will make up the bulk of the waste being solublized. These produce brines of low density (<1.35). It is not fully understood what this means to the time it takes to empty a tank and has potential of causing some post transfer difficulties including stratification of waste and precipitations. There is also the potential for sparingly soluble salts to dissolve at one location in the salt cake and reprecipitate in another location.

The strategy of how waste retrieval can be quickly accomplished has not been fully worked out. Some of the options are to uniformly add water on the surface of the waste – with or without standing pools. The outside—in method would focus on retrieving waste from the outside edge of the tank. The inside-out method has the potential of using the least water inventory.

*** The fate of insoluble material has yet to be determined. There is the possibility that the insoluble material may form an impermeable barrier on the surface of the waste as it accumulates as the soluble material is dissolved. It has also been speculated that the aluminum may form a gel as hydroxide is washed out. This gel may be impermeable.

Consequences of Not Filling Need: The current baseline has high costs with uncertain performance capability. This alternative development process will reduce the risk of unacceptable performance, and will result in significant cost savings and/or performance improvements.

Program Baseline Summary (PBS) No.: TW04

Work Breakdown Structure (WBS) No.: 5.02.01.02.07.12

TIP No.: During S-112 demonstration or in subsequent tanks

13	<p><i>Functional Performance Requirements:</i> These will be established based on the range of performance capabilities determined during this activity and to meet the established retrieval performance objectives.</p> <p>Outsourcing Potential: Retrieval system performance specifications would result from this effort and would be provided to the SST Retrieval Privatization Contractor.</p>
**	<p><i>Schedule Requirements:</i> Based on the SST Retrieval Program Mission analysis Report HNF-2944 and current Tri-Party Agreement milestones for SST retrieval, a full-scale demonstration of saltcake retrieval using dissolution is to be completed in tank S-112 by September 30, 2005. The introduction of water into S-112 will not happen before September 2002. A total of 36 SSTs are required to be retrieved by the year 2012 and all of the SSTs being retrieved by 2018. This effort could provide a cost effective retrieval technology to support current waste retrieval commitments that might otherwise be missed because of budget or time constraints.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$4,000,000,000
18 *	<p><i>Potential Cost Savings Narrative:</i> The current system of past practice sluicing cost estimate is approximately \$ 120 million per tank. If a system could be developed and demonstrated, it could subsequently be applied for waste retrievals to realize cost savings of 50% or more in 66 SSTs containing 23 million gallons of saltcake.</p>
**	<p><i>Technical Basis:</i> This task will establish technical performance capability of a sprinkler system for retrieval of saltcake from SSTs. After the capabilities are determined, they will be compared to the current past practice sluicing to identify if this method is technically better than the past practice sluicing system for waste retrieval.</p>
19	<i>Cultural/Stakeholder Basis:</i> N/A
20	<p><i>Environment, Safety, and Health Basis:</i> By applying this method, the length of time and amount of water in the SST can be reduced. This will reduce the potential for tank leakage and reduce to amount should a leak develop. Health and safety risks to workers and the environment should be reduced by implementing this technology. Safety and health risk will be compared to the existing system.</p>
21	<p><i>Regulatory Drivers:</i> A failure to deliver feed to the privatization contractor, which is within the correct feed envelopes, will result in delay in processing, and may impact agreements to proceed with the RPP program commitments.</p>
22 *	<p><i>Milestones:</i></p> <p>T04-18-1B1 Retrieve Waste from all Remaining Single-Shell Tanks (M-45-05) 9/28/18 Risk Score: 0, T04-03-100, T04-04-100, T04-05-100</p>
23 *	<p><i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20)</p> <p>ID-3857 HLW to Treatment Risk Score: 3</p>
24	<p><i>TSD System:</i> Single-Shell Tank systems</p> <p>ID-1722 Underground Storage Tanks Risk Score: 1</p>
25	<p><i>Major Contaminants:</i> 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).</p>

26	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> 09/30/2001
29 *	<i>Latest Date Required:</i> 09/30/2005 – to support S-112 retrieval technology demonstration
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> The current baseline technology is to use the past practice sluicing method adopted by Project W-320 and as directed in the DOE letter 95-PRI-073. <i>Technology Insertion Point(s):</i> During S-112 demonstration or in subsequent tanks
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i> Post 2020
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.A. (Dan) Reynolds, CHG, 509-373-3115, F/509-373-4641 Daniel_A_Reynolds@rl.gov
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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Radionuclide Source Term from Tank Residuals
2 *	<i>Need Code:</i> RL-WT068
3 *	<i>Need Summary:</i> Remediation and closure of high-level waste tanks at Hanford will leave residual solids and liquids that are estimated to be one of the major long-term radionuclide sources into underlying vadose zone sediments. However, the actual release rate of technetium, selenium, iodine, carbon, uranium, chromium, nitrate, and nitrite (the major predicted dose contributors) from the residuals is essentially unknown. A fundamental understanding of the true radionuclide source-term from the residuals is needed to base sound cost/benefit/risk decisions regarding the extent of waste removal actually required from the tanks to meet site-wide groundwater protection standards. A better understanding of the presence and impact of complexants on contaminant mobility is also required. Finally, methods to assay the remaining source term left in the tank at the completion of retrieval are needed.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval and Closure <i>PBS No:</i> RL-TW04 and RL-TW11
9 *	<i>National Priority:</i> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort, Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms. <p>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</p>

	<p>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.</p>
12	<p><i>Need/Problem Description:</i> A composite analysis for the Hanford Site has shown that the radionuclide source term from residual solids in Hanford HLW tanks is one of the most significant long-term dose contributors on site, especially from ^{99}Tc, ^{79}Se, and uranium isotopes. However, the radionuclide release rate from these solids is virtually unknown and better information on inventory in the tank residuals is also needed. If it can be shown that the release of these important elements remains low for time periods of regulatory concern (typically 1,000 to 10,000 years), then it may be possible to leave a higher percentage of residues in the tanks without significant long-term impacts to groundwater and future populations.</p> <p>Recent chemical analyses of sludges obtained from tanks at Hanford and at Savannah River suggest that significant fractions of Tc and Se occur in highly insoluble, non-mobile reduced forms in some sludges. Release of Tc and Se from these sludges will be governed by the rate of oxidation of any reduced phase, releasing soluble and highly mobile pertechnetate and selenate anions. Transport of oxidants in the sludge is the likely rate-controlling process. Sludge characteristics/properties affecting permeability to oxidants need to be determined. The effects of proposed tank fillers on sludge aging (phase transformation), and how aging affects sludge permeability also needs to be determined. A better understanding of the presence and impact of complexants on contaminant mobility is also required.</p> <p>In-situ measurement of the radionuclides, that are important to closure of the tank, remaining in the tank will be very helpful. The amounts, locations, and volumes may be critical to having a closure plan that is effective. A better understanding and measurement is needed of how much technetium is soluble and how much is insoluble and where it may be left in the tanks. The insoluble technetium may be insoluble due to valence state or the technetium may be adsorbed on other insoluble material. It can be expected that the limited sampling capability will preclude removing samples for laboratory analysis. It would be preferred if a method could be developed that could work in the dome space of the tank and effectively see across the tank. An integrated readout may be possible. Potential devices may be spectral gamma analysis, gamma radiography, IR heat camera, etc.</p> <p>If a central probe will not be adequate then a contact probe or near contact probe on a delivery device (arm or crawler) will be necessary. The probe that this delivery device may deliver could be Raman Spectroscopy, beta recoil mass spec., neutron activation, x-ray florescence, or any other probe that may be applicable. Work needs to be done on a delivery system and a probe that will work.</p> <p>*** *** *** Consequences of Not Filling Need: Without data for long-term tests under expected conditions, the environmental analyses will use conservative parameters which would require DOE to set tighter requirements on tank waste retrieval requirements or on closure design. Inadequate specification of release rates could lead to future environmental impacts.</p> <p>Program Baseline Summary (PBS) No.: TW04 and TW11 Work Breakdown Structure (WBS) No.: 5.02.01.01.01.01 and 5.05.01.01 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> A fundamental understanding of the true radionuclide source-term (inventory and release rate) from tank residuals over time is needed. Assess processes leading to mobilization and release of radionuclides from representative Hanford sludges.</p>

	Determine impacts (if any) of tank filler material on release rates. Estimate rate of radionuclide release from sludges under environmental conditions expected at the Site for input to future composite analyses (CA). A better understanding of the presence and impact of complexants on contaminant mobility is also required, in part, to evaluate potential mitigation technologies (such as capping and grouting) and their effect on reducing mobilization.
	** Schedule Requirements: The processes need to be understood by the end of FY 2004, to support long term risk assessment of closure alternatives for the Hanford Tank Farm Closure Environmental Impact Statement.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$250,000,000
18 *	<i>Potential Cost Savings Narrative:</i> If the interim retrieval goal specified currently in Tri-Party Agreement milestone M-45-00 is eventually replaced by a retrieval goal based on long-term risk to human health and the environment (through the process outlined in the 1993 change request that led to adoption of the M-45 series Tri-Party Agreement milestones), then release rate may be an important input to specification of retrieval performance requirements on a tank-by-tank basis. This would allow more efficient and cost-effective targeting of retrieval technologies based on degree of risk posed by the tank contents and other factors. Project W-320 costs for designing, installing, and operating equipment for sluicing tank 106-C are on the order of \$ 120 million. This includes substantial infrastructure costs that will not need to be repeated on a tank-by-tank basis. However, additional costs (in the tens of millions of dollars) are expected for removing the hard heel that will remain upon completion of sluicing operations in tank C-106. After the initial retrieval operations, retrieval costs on a per tank basis are expected to be in the tens of millions of dollars. Costs per unit volume of material removed can be expected to be higher as requirements for degree of waste removal increase. Potentially hundreds of millions of dollars in cost savings for waste retrieval are possible if final waste retrieval requirements are based on risk, and a better understanding of the radionuclide retention properties of tank residuals can be developed to support such final retrieval and closure requirements.
	** <i>Technical Basis:</i> The interim goal for tank waste retrieval for closure is to remove 99% of the waste from all HLW tanks (ref: Tri-Party Agreement milestone M-45-00). It may not be necessary to achieve removal efficiencies to this degree if the tank residuals demonstrably retain their radionuclide inventory over time periods of regulatory concern.
19	<i>Cultural/Stakeholder Basis:</i> Expressed stakeholder values include getting on with waste retrieval and closure in a timely manner that protects human health and the environment. Having a better understanding of long-term risk implications of retrieval and closure decisions will facilitate reaching consensus on cleanup requirements.
20	<i>Environment, Safety, and Health Basis:</i> Contaminant release rate is an important input to assessment of long term performance of tank farm closure alternatives.
21	<i>Regulatory Drivers:</i> The Record of Decision for the RPP EIS (62 FR 8693) requires a decision to proceed with a NEPA process for tank farm closure, when sufficient information is available. Contaminant release rates will be an important input to the assessment of long-term performance of closure alternatives that will be considered. Tri-Party Agreement milestone M-45-06-T01 requires preparation and submittal of a RCRA closure plan which must be approved prior to initiation of closure activities. The Change Control Form (M-45-98-03) for the vadose zone Tri-Party Agreement milestones indicates the NEPA process for closure is a predecessor to preparation of a Closure Plan for closing tank farms under RCRA.

22 *	<i>Milestones:</i> T04-18-1B1. T04-24-051, T04-24-052
23 *	<i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20) ID-2118 Stabilized Tanks Risk Score: 1 ID-3857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> 9/30/02
29 *	<i>Latest Date Required:</i> 9/30/07
Baseline Technology Information	
31	<i>Baseline Technology/Process:</i> There is no baseline technology for characterizing the radionuclide release source-term from tank residuals. However, several techniques have been developed under the RPP program that are applicable to this effort. Technology Insertion Point(s): TBD
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.A. (Dan) Reynolds, CHG, 509-373-3115, F/509-373-4641 Daniel_A_Reynolds@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-9876, F/509-372-2781, Billie_M_Mauss@rl.gov
36 **	<i>Other Contacts:</i> A. F. (Anne-Marie) Choho, CHG, 509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov N. W. (Nick) Kirch, CHG, 509-373-2380, F/509-372-0065, Nicholas_W_Nick_Kirch@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Advanced Approaches for Reducing Waste Volume Stored in DSTs
2 *	<i>Need Code:</i> RL-WT088
3 *	<i>Need Summary:</i> The volume of double-shell tank (DST) space is limited and may restrict the volume of single-shell tank (SST) waste retrieved for storage and staging in DSTs. Given the current SST retrieval schedule at Hanford, it is projected that additional DST space will be needed in the FY 2010 time frame. The Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) calls for evaluation of options and actions to increase available DST space in support of SST retrieval. The current process is to remove water through the 242-A Evaporator within administrative controls limiting waste concentration. Advanced approaches for reducing waste volumes sent to and contained within DSTs are needed to minimize the need for additional DST space and reduce the associated costs for storing and staging retrieved SST wastes. Possible options include treatment of retrieved SST waste to remove LAW that can then be stored or disposed outside the DST System and developing a better understanding of waste concentration to relax administrative control on evaporator operations. Several options were discussed in the Tank Space Options Report, RPP-7702, issued in March 2001, to help increase the available DST waste storage space including raising the allowable waste levels, combining aging waste, using restricted tank capacity, concentrating to higher specific gravity, etc.
4 *	<i>Origination Date:</i> November 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No:</i> ORP-TW04
9 *	<i>National Priority:</i> <u>X</u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. _____ 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
PROBLEM DESCRIPTION INFORMATION	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms. The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from

	<p>the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • • Store and stage SST waste in DSTs, and Place SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<p><i>Need/Problem Description:</i> The volume of available tank storage space currently within the DST system is limited and may potentially restrict the volume and rate at which SST waste can be retrieved and then stored in these DSTs without constructing new DSTs at a large cost. Given the current schedule for SST retrieval, it is projected that additional DST space will be needed in 2010. The M-45-00-01A modifications to the Tri-Party Agreement calls for an evaluation of options for actions that could be taken to increase the available tank space for SST retrieval. The only currently active waste processing option for increasing available DST space is the removal of water by evaporation in the 242-A Evaporator. Other options were identified in RPP-7702. For continued safe storage of waste in the DSTs, administrative controls restrict how much the waste can be concentrated by this process. When the pretreatment and LAW vitrification plants are operating, this will become the baseline process for removing waste for the DSTs to make space for continued SST retrieval.</p> <p>Process technologies or scientific advances that will create options for increasing the available space in the DST's are needed to ensure optimal retrieval capabilities are available to retrieve SST waste. These technologies could be used in conjunction with the existing piping and infrastructure associated with the 242-A Evaporator as an enhanced waste management facility, could be separate units, or could be part of the waste treatment plant. Some possible approaches included: 1) removing a low activity waste (LAW) stream from retrieved SST waste or other stored waste that would be suitable for storage outside a DST or disposal if converted to an acceptable waste form; 2) accelerating or improving the processing rate of the waste treatment plant, particularly the immobilization of the LAW fraction because this comprises the majority of the waste volume; 3) developing improved technical understanding that would relax administrative limits on evaporator operation; or 4) combining aging waste. Other approaches that may be worth considering also include: 1) electrodialysis reversal (EDR); 2) fractional crystallization, 3) cation exchanging molecular sieve, sized to allow sodium exchange, and to exclude strontium and larger alkali and actinide cations, and use a portable evaporators at the job location., 4) anion (nitrate, nitrite, carbonate, etc) destruction or separation.</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.02 TIP No.: TBD</p>
13	<p><i>Functional Performance Requirements:</i> Current forecasting for DST space utilization and SST retrieval as identified in document Single-Shell Tank Retrieval Sequence and Double-Shell Tank Space Evaluation (RPP-8554) issued in September 2001 indicates that two new million gallon DST's will be needed by 2010 and this construction activity will require substantial budget resources. Additional tanks will be needed in succeeding years. Process alternatives, technical approaches, or alternative tank farm management practices are needed to effectively create this</p>

	volume of tank space by this time. It is important that any individual solution be effective from a complete systems perspective.
	*** <i>Schedule Requirements:</i> Additional DST space will be needed in 2010.
14	<i>Definition of Solution:</i> Creation of sufficient DST space so that the SST retrieval schedule is maintained without needing to construct new DSTs, thus providing significant cost savings while maintaining project schedule. Any proposed solution must account for the entire systems effect on the waste treatment plant and tank farm operations.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> Significant cost savings by not building additional DSTs, and the ability to maintain SST retrieval schedule and potentially enable accelerated retrieval and site risk reduction
17 *	<i>Potential Cost Savings</i> \$150,000,000
18 *	<i>Potential Cost Savings Narrative:</i> Current estimates are that each additional DST will cost \$75M and at least two new DSTs will need to be constructed through 2010 per document RPP-8554. Additional DSTs will be needed beyond the 2010 time-frame at a cost of roughly \$75,000,000 each. Planning studies have updated previous detailed estimates for construction of new DSTs.
	*** <i>Technical Basis:</i> Given the current schedule for SST retrieval, it is projected that additional DST space will be needed in 2010. The M-45-00-01A modifications to the Tri-Party Agreement calls for an evaluation of options for actions that could be taken to increase the available tank space for SST retrieval. The only currently active waste processing option for increasing available DST space is the removal of water by evaporation in the 242-A Evaporator. Other options were identified in RPP-7702. For continued safe storage of waste in the DSTs, administrative controls restrict how much the waste can be concentrated by this process. When the pretreatment and LAW vitrification plants are operating, this will become the baseline process for removing waste for the DSTs to make space for continued SST retrieval.
19	<i>Cultural/Stakeholder Basis:</i> Maintaining the schedule for retrieval of SST waste and storage in DSTs is a priority.
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i> M-45-00-01A modifications to the Tri-Party Agreement
22 *	<i>Milestones:</i> M-45-12-T01 (2/28/2002) Options report on assessment of actions that could be taken to increase available tank space for SST waste retrieval.
23 *	<i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20)
24 *	<i>TSD System:</i> Double Shell Tank System and Single Shell Tank System
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i> 9/30/03 (approaches defined)
29 *	<i>Latest Date Required:</i> 9/30/06 (approaches defined)
Baseline Technology Information	

30	<i>Baseline Technology/Process:</i> Running wastes through the 242-A Evaporator to reduce the volume. Constructing new DSTs and ultimately cleaning and closing the new tanks.
31	<i>Life-Cycle Cost Using Baseline:</i> \$75M for each new DST, plus the cost to maintain, operate, and then close the tank.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> L. A. (Les) Fort, CHG, 509-376-0178, F/509-373-4641, Leslie_A_Les_Fort@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, Billie_M_Mauss@rl.gov
36 *	<i>Other Contacts:</i> A. F. (Anne-Marie) Choho, CHG, 509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry_W_Cammann@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Alternate Retrieval Methods from Potentially Leaking Single-Shell Tanks (SSTs)
2 *	<i>Need Code:</i> RL-WT089
3 *	<p><i>Need Summary:</i> Between 1944 and 1964, 149 SSTs were built in the 200 East and 200 West Areas on the Hanford Site central plateau. Sixty-seven of Hanford's 149 SSTs are confirmed or assumed leakers that have leaked an estimated 750,000 to 1,050,000 gallons to the surrounding vadose zone (HNF-EP-0182-148, "Waste Tank Summary Report for Month Ending July 31, 2000). The SSTs currently contain approximately 35 million gallons of waste. Although no waste has been added to the SSTs since November 1980, all of the SSTs have exceeded their original design life of roughly 20 years and continue to deteriorate over time.</p> <p>The baseline method for Single-Shell Tank (SST) waste retrieval is "past practice" hydraulic sluicing. While this technique has proven to be effective in tanks believed to be sound, hydraulic sluicing raises concerns in tanks that are known or suspected to be leaking. These concerns are due, in part, to the reliance on the use of liquids to mobilize and retrieve the wastes.</p> <p>A need exists for alternate waste retrieval technologies that use little or no liquids to mobilize and retrieve SST wastes from potentially leaking tanks.</p>
4 *	<i>Origination Date:</i> FY 2001
5 *	<i>Need Type:</i> Technology Opportunity
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No:</i> RL-TW04
9	<p><i>National Priority:</i></p> <p><u>X</u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>2. <u>Medium</u> - 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).</p> <p>3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The Single-Shell Tank (SST) Interim Closure Project is responsible for Program/Project Planning and Execution; Environment, Safety, Health, and Quality Assurance; Facility Operations; Engineering; Maintenance; Interim Stabilization; and Technology Development, Demonstrations, and Deployments necessary for the safe and cost effective storage, retrieval, immobilization, and closure of SST wastes, associated underground storage tanks, and ancillary piping and equipment. Safe storage of wastes includes day-to-day operations of the SST's and saltwell pumping operations to remove pumpable liquids from the SST's for transfer to double-shell tanks (DST's) to achieve interim stabilization and minimize the potential for SST leakage. Retrieval projects will be conducted to remove wastes from SST's for placement in DST's in support of waste feed delivery to the Waste Treatment Plant and eventual waste immobilization. An integral part of SST waste retrieval operations is leak detection, monitoring, and mitigation. Safe storage, retrieval, and closure activities associated with SST wastes are also supported by Special Projects and Vadose Zone Projects to characterize groundwater flow</p>

	and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes.
12	<p><i>Need/Problem Description:</i> Sixty-seven of Hanford's 149 SSTs are confirmed or assumed leakers. All 149 SSTs have exceeded their design lives by 20 to 40 years and they continue to deteriorate with time. The primary mode of SST failure has been determined to be stress corrosion cracking. The configuration of SSTs and the wastes contained therein make it difficult to conduct tank integrity testing in support of tank failure analyses. Additionally, the SSTs do not conform to current Resource Conservation and Recovery Act requirements for underground storage tank design and operations. Consequently, there is a "bias for action" to minimize the potential for tank leakage to the environment. This "bias for action" is being accomplished through interim stabilization of the SSTs to remove pumpable liquids followed by the ultimate retrieval and processing of remaining SST wastes.</p> <p>Although "past practice" sluicing was recently used in FY 1999 to retrieve SST wastes in tank C-106 (a sound tank not suspected to be leaking), there is concern over adding liquids to tanks of questionable integrity due to the possibility of creating tank leaks or exacerbating existing leaks thereby driving contaminants deeper into the vadose zone and possibly into the groundwater system beneath the SST tank farms.</p> <p>A need exists to demonstrate waste retrieval technologies that use little to no liquids to mobilize and retrieve tank wastes. Those technologies proposing the use of limited amounts of liquids must demonstrate the ability to conduct leak mitigation during retrieval operations should a leak be detected.</p> <p><i>Consequences of Not Filling Need:</i> Given (1) the age of the SSTs, (2) the fact that 67 SSTs are confirmed or assumed leakers and they continue to deteriorate, (3) all SSTs have exceeded their design lives, and (4) tank configuration makes it difficult to perform tank integrity inspections, the consequences of not filling this need is increased potential for leakage losses during retrieval operations if past practice sluicing is used. This could result in cessation of tank waste retrieval operations with resultant impacts to waste feed delivery to the Waste Treatment Plant. Furthermore, if the leakage losses are great enough and migration to the water table is imminent, then the tank farm could be thrust into RCRA assessment and corrective action mode with associated costs for characterization, evaluation, and remediation. At a minimum, increased tank farm surveillance will be required to track the fate and transport of leaked contaminants through the vadose zone.</p> <p>Failure to fill this need will also impede efforts to find more environmentally acceptable technologies for waste retrieval that minimize or eliminate the use of liquids to mobilize and retrieve wastes or provide adequate leak mitigation provisions to minimize the likelihood of leakage losses during retrieval operations if limited amounts of liquids are used.</p> <p>The current past practice sluicing baseline has relatively high costs and uncertain performance efficiency given the variety of waste forms in the SSTs. This need statement addresses demonstration of alternative retrieval technologies and the development of cost and performance data for each technology to support cost-benefit tradeoffs during pre-conceptual and conceptual retrieval system design efforts.</p> <p>** Program Baseline Summary (PBS) No.: TW04 ** Work Breakdown Structure (WBS) No.: 5.02.01.01.01.01, 5.02.01.01.03.02 ** TIP No.: M45 Series TPA Milestones</p>

13	<p><i>Functional Performance Requirements:</i> The SSTs currently contain approximately 35 million gallons of wastes. This waste is comprised of roughly 21.5 million gallons of non-pumpable saltcake, 12 million gallons of sludge, and 1.5 million gallons of supernatant. The SSTs contain approximately 23,000 curies of contaminants of concern. Approximately 95% of these contaminants are contained in 70 of the SSTs. The SSTs also contain miscellaneous hardware (e.g., airlift circulators, thermocouple trees, steam coils, manual tapes, etc.) and other materials (e.g., experimental fuel elements, cobalt slugs, cement, diatomaceous earth, etc.).</p> <p>Pumpable liquids have been removed from approximately 75% - 80% of the SSTs and saltwell pumping operations continue. Current plans are to remove all pumpable liquids from the SSTs and achieve interim stabilization by 2004. Although saltwell pumping operations are removing the bulk of the liquids from the SSTs, some liquids still remain in the SSTs due to unpumpable regions and capillary action within the interstitial spaces of the waste. Some estimates suggest that as much as 50,000 gallons of liquids may still remain in some tanks following saltwell pumping operations.</p> <p>The 149 SSTs were constructed in various configurations. One-hundred thirty-three have 75 feet diameters with nominal capacities of 500,000 gallons, 750,000 gallons, or 1,000,000 gallons. The remaining 16 SSTs have 20 feet diameters and nominal capacities of 55,000 gallons.</p> <p>The 75 feet diameter tanks are domed top, reinforced concrete cylinders, varying in height from 29 feet to 45 feet. The concrete cylinders are lined with steel plate on the sides and bottom. The bottoms of most tanks are dished with a depth of 12 inches. The tanks are below grade with at least 6 feet of soil cover for radiation shielding.</p> <p>Risers penetrating the tank domes provide access to the tanks. Existing risers vary in diameter from 4 inches to 42 inches. Fifty-seven of the tanks contain pipes used as liquid observation wells to measure waste levels in the tanks using neutron probes, manual tapes, and other techniques. Sixty-four of the 75 feet diameter tanks do not have a 42 inch central riser for access. Thirty-nine of the 75 feet diameter tanks have four or five centrally located 42 inch risers. Although new risers can be added to the SSTs, this is a very costly proposition.</p> <p>The sixteen smaller tanks are 20 feet in diameter and 24 feet in depth. They have a nominal capacity of 55,000 gallons. They are reinforced concrete cylinders with steel liners. There are several pipe penetrations in the top of the tanks ranging in size from 1.5 to 12 inches in diameter. There is also a 42 inch diameter manhole in the top of the tanks located 12 feet below grade.</p> <p>The contaminants of concern that pose the greatest long-term threats and are of particular interest to the SST Program include nitrite, nitrate, ethylenediaminetetraacetic Acid, carbon-14, selenium-79, technetium-99, iodine-129, and uranium-238. These contaminants are major factors in determining subsurface investigation methods, associated corrective measures, residual tank waste criteria, and tank closure plans.</p> <p>Candidate technologies must be capable of making tank entries within the confines of the tank configurations described above. In addition, retrieval technologies must use very little to no liquids to mobilize and retrieve tank wastes. If limited amounts of liquids are proposed for use, then the retrieval technology must be capable of mitigating potential tank leakage through engineering design and application (i.e., confined sluicing, auxiliary pumping, etc.). The radioactive saturated salt/saltcake waste within the SSTs is an aggressive/hazardous environment.</p> <p>Technologies incorporating slurry transfer capabilities must be accomplished with minimal liquid</p>
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use. The ability to restart waste transfer operations following a shutdown without additional liquid addition is highly desirable. The ability of the waste transfer system to mobilize various waste forms (i.e., fine particulates to large pieces of waste) is desirable. Although physical properties (i.e., particle size, density, viscosity, etc.) of SST waste are somewhat limited, some information is available on a tank-specific basis and can be provided.

All technologies must be capable of establishing and maintaining radiological confinement and containment to control airborne and other types of contamination spread. Furthermore, technologies that minimize the number of moving parts that must come in contact with the waste and are easy to decontaminate and maintain are highly desirable.

Possible Concepts: Tank waste retrieval projects are charged with determining the maximum leakage loss that can occur during retrieval and still comply with applicable Federal and State regulations. This allowable leakage will be based, in part, on expected residual waste volumes in the SSTs and inventories of contaminants in surrounding vadose zone soils as a result of past tank leaks.

It is unlikely that only one economically attractive retrieval technology will be suited to retrieval of all potentially leaking tanks. Furthermore, acceptable leakage volumes, if any, will likely be assessed on a tank- or tank farm-specific basis. Therefore, SST waste retrieval efforts will benefit from having a range of technologies at their disposal. Technologies of greatest interest will be those that (1) minimize or mitigate the potential for leakage losses during retrieval operations, (2) use minimal amounts of liquids and can operate with minimal liquid levels within the SSTs, and (3) incorporate dry retrieval technologies that use no water.

A multitude of candidate retrieval technologies have been identified by prior EM-50 Technology Development Programs and EM-30/EM-40 technology assessments. The following is a partial listing of retrieval technologies potentially applicable to leaking SSTs:

Dislodging, Fluidic
Medium and high pressure water jets
Confined sluicing
Fluidic mixers
Saltcake dissolution

Dislodging, Compressed Air
Cryogenic gas
Sand blasting
Frozen carbon dioxide pellets

Dislodging, Mechanical
Jack hammer
Grinders
Scabblers
Diamond shavers
Robotic crawlers with end effectors and manipulators

Dislodging, Shock Wave
Ultrasonic horn
Pulsed electric power
High pressure pulsed jet

	<p>Conveyance Air conveyance Mechanical conveyance Multi-phase based on using in-tank supernatant</p> <p>In-Tank Leak Mitigation Modified mining strategy Interim collection tank In-tank leak detection (e.g., tracers) Surface and subsurface barriers Leak plugging fluids (e.g., colloidal silica) Auxiliary pumping schemes</p> <p>As mentioned previously, the Tri-Party Agreement contains requirements for retrieval technology demonstrations. Current plans are to demonstrate saltcake dissolution and fluidic pumping technologies in tanks S-112 and S-102, respectively. Tank S-112 contains 6 kgal of sludge and 517 kgal of saltcake. Tank S-102 contains 105 kgal of sludge and 387 kgal of saltcake.</p> <p>Tank C-104 has been selected for demonstration of a robotic, crawler-based technology. Tank C-104 contains 263 kgal of sludge only.</p> <p>In general, the SST Program has identified a need to conduct technology demonstrations in the areas of saltcake dissolution, confined sluicing, saltcake/sludge retrieval, dry retrieval, and congested/limited access retrieval.</p> <p>Outsourcing Potential: Demonstration of alternative retrieval technologies will identify where industry capabilities exist and where additional technology development would be beneficial. Existing technology capabilities will be infused from other industries (e.g., mining, petroleum) to benefit SST waste retrieval at the Hanford Site and elsewhere. Technology demonstrations envisioned under this need statement could result in private industry, university, and DOE Site collaborations.</p>
**	<p>Schedule Requirements: Under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement, M-45 Series Milestones), a tentative agreement establishes a risk-based strategy and initial actions necessary for the Department of Energy to demonstrate alternative SST retrieval technologies. The technologies must be suitable for use in suspect or leaking SSTs to minimize the potential for unacceptable leakage losses to the environment during retrieval operations, and to develop performance and cost data necessary for application to future retrieval actions. In addition to demonstrating waste retrieval technologies, initial actions will focus on SSTs that pose the greatest risk to the environment and on maximizing available double-shell tank (DST) space. Key elements of the new risk-based SST retrieval strategy include:</p> <p>Implement a risk-reduction strategy and retrieve the “worst tank waste” first.</p> <p>Demonstrate SST waste retrieval and leak detection, monitoring, and mitigation technologies to develop cost and performance data.</p> <p>Transfer no less than 800 curies of long-lived, mobile radionuclides into approximately 2 million gallons of DST space for retrieval of tanks S-112 and S-102.</p> <p>Complete construction for tank C-104 retrieval that will transfer approximately 23,000 curies of plutonium into approximately 800,000 gallons of DST space.</p> <p>Update tank farm closure work plans.</p> <p>Assess options for creating more DST tank space.</p>

	<p>Proposed milestones and schedules for retrieval activities under the Tri-Party Agreement include the following:</p> <p><u>Technology Demonstration – Tank S-112</u> Submit functions and requirements for tank S-112 technology demonstration by 12/30/01. Complete tank S-112 technology demonstration design by 5/31/03. Complete tank S-112 technology demonstration construction by 9/30/04. Complete full-scale waste retrieval demonstration in tank S-112 by 9/30/05.</p> <p><u>Technology Demonstration – Tank C-104</u> Submit functions and requirements for tank C-104 technology demonstration by 12/31/01. Complete tank C-104 cold technology demonstration by 6/30/04. Complete tank C-104 technology demonstration design by 9/30/04. Complete tank C-104 technology demonstration construction by 9/30/06.</p> <p><u>First Full-Scale Retrieval – Tank S-102</u> Submit functions and requirements for tank S-102 retrieval by 10/30/02. Complete tank S-102 retrieval system design by 3/31/04. Complete tank S-102 retrieval system construction by 11/30/05. Complete tank S-102 waste retrieval by 9/30/06.</p> <p><u>Second Full-Scale Retrieval – Tank To Be Determined</u> Establish completion date for initial waste retrieval by 12/31/02. Submit functions and requirements document by 4/30/04. Complete initial retrieval project design by 6/30/06.</p> <p>NOTE: Actual project schedules establish earlier due dates to ensure the meeting of the Tri-Party Agreement milestones listed above.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area: Tanks Focus Area (TFA)</i>
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i>
18 *	<i>Potential Cost Savings Narrative:</i> It is difficult to quantify the cost savings potential of alternative retrieval technologies without the performance data that will be derived through technology demonstrations conducted in response to this need statement. In general, alternatives to past practice sluicing are expected to be more costly, however, this cost increase will be offset by reduction in leakage loss potential during retrieval operations and subsequent requirements to characterize and remediate contaminated soils surrounding the SSTs. Anticipated cost savings or avoidances are on the order of tens of millions of dollars per tank.
**	<i>Technical Basis:</i> Alternatives to past practice sluicing are needed to mobilize and retrieve wastes from potentially leaking SSTs to ensure adequate protection of the environment. This technology need statement will result in the demonstration of retrieval technologies that use little to no liquid to mobilize and retrieve SST wastes thereby minimizing the likelihood for leakage losses during SST waste retrieval. Demonstration of alternative retrieval technologies will provide cost and performance data to ensure the cost effective retrieval of wastes from Hanford's 149 SSTs in a manner protective of human health and the environment.
19	<i>Cultural/Stakeholder Basis:</i> Leakage mitigation during SST waste retrieval operations is a major concern of the Hanford Site regulators and stakeholders. This concern is reflected in the Tri-Party Agreement milestones, comments on the Hanford Defense Waste Environmental Impact Statement and Record of

	Decision, Hanford stakeholder values, and in other public documentation.
20	<i>Environment, Safety, and Health Basis:</i> Successful demonstration of retrieval technologies that use little or no liquid to mobilize and retrieve SST wastes will provide a more environmentally acceptable situation by minimizing the likelihood for leakage losses during retrieval operations. This will potentially reduce the amount of contaminated soils surround the tanks in the vadose zone requiring remediation and minimize the likelihood of contaminants being transported into the groundwater system beneath the tank farms.
21	<i>Regulatory Drivers:</i> Recently negotiated Tri-Party Agreement M-45 Series milestones require alternative retrieval technology demonstrations focused on saltcake dissolution, fluidic mixing, and robotic crawler-based systems over the next 5 years. Demonstration of retrieval technologies that use little to no liquid will minimize the likelihood for leakage losses during retrieval providing a more environmentally and regulatory acceptable situation.
22 *	<i>Milestones:</i> Refer to Section 13A on Schedule Requirements.
23 *	<i>Material Streams:</i> Sludge, Saltcake, Liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i>
28 *	<i>Earliest Date Required:</i> 9/30/03
29 *	<i>Latest Date Required:</i> 9/30/06
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> The current baseline technology for waste retrieval from SSTs is past practice sluicing. This technique uses relatively large volumes of liquid introduced into the tank waste through a sluicing nozzle to mix and mobilize the wastes for retrieval. The resultant slurry is removed from the SST and is transferred to a DST using a slurry pump and waste transfer system. This baseline technology has been used at Hanford since the 1950's. The current baseline cost is roughly \$35 million per tank to install a past practice sluicing system. While this technology has been used successfully in SSTs with structural and containment integrity, there is a concern over using past practice sluicing in tanks of questionable integrity due to the potential for leakage losses during retrieval operations. <i>Technology Insertion Point(s):</i> (M45 Series TPA milestones, as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> David B. Smet, (509) 372-3537; F – (509) 372-2825; David_B_Smet@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov

36 *	<i>Other Contacts:</i> Jerry W. Cammann, CHG, 509-372-2757, F/509-373-0605, Jerry W Cammann@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov
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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**Element of a Site Need required by CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Chemical and Physical Behavior of Sludge Wastes
2 *	<i>Need Code:</i> RL-WT090
3 *	<i>Need Summary:</i> Provide additional chemical, physical, and hydrodynamic information to guide the retrieval, delivery, and caustic leaching of Hanford tank sludge wastes.
4 *	<i>Origination Date:</i> November 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval PBS No.: RL-TW04
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms. <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<i>Need/Problem Description:</i> Wastes must be transported and treated with minimum cost and delay. To this end, the transfer and treatment equipment must be designed correctly, and the operating plans must be accurate. Successful design and operation both rely on accurate knowledge of the chemistry and physical properties of the wastes to be treated. Although a good deal of information has been obtained about the elemental composition of the waste, we do not yet

have complete knowledge of the chemical compounds formed by these elements. Knowledge of the chemical compounds present in sludge wastes is important to predict the degree of completeness of caustic leaching and the manner in which leach rate and completeness are affected by variations in process parameters.

Needs related to leaching: Knowledge of the chemical compositions of the wastes by itself will provide general indications of leachability and the effect of process parameters on leachability. However, to develop a reliable capability for quantitative prediction of leachability, this knowledge must be coupled with leach tests on actual waste samples. Such leach tests have already been performed on 30 samples of sludge, representing 75% of the total sludge volume at Hanford. Testing of another 17 samples would complete a plan to cover 93% of the sludge. Information is needed about the rate, as well as the total extent of dissolution that may be obtained under potential processing conditions. A special concern involves the REDOX-type sludge wastes, which contain most of the hard-to-remove chromium; these wastes require additional testing to confirm chromium removal efficiencies.

Basic kinetic information will also assist in designing and operating the leaching step most efficiently. Systematic evaluations of the effects of temperature, alkalinity, ionic strength and other parameters on the rates of dissolution and solid state phase transformations (such as interconversion of gibbsite to boehmite, or reactions rates involving sodium aluminate) are presently unavailable. Our present level of understanding of the behavior of chromium in the Hanford waste tanks is based only on observations at a few selected conditions for specific wastes. There are few available data on the equilibrium behavior of chromium compounds in tank-like environments, and kinetic information under these conditions is virtually nonexistent. Like aluminum, chromium dissolution in basic solutions is not an instantaneous process; preliminary unpublished data on the dissolution of chromium solids in high base suggests a significant decrease in solubility with time.

The chromium system is complicated by its redox chemistry. The oxidation state of chromium in the waste is surmised only from its solubility behavior. Thus, systematic evaluation of the solubility and kinetics of chromium compounds must also cover the oxidation of Cr(III) to Cr(VI). Fundamental investigations of the equilibria and kinetics of reactions involving the Cr(III) – Cr(VI) transitions are necessary. The chemistry is likely to be strongly dependent on temperature, alkalinity and various other parameters. Thus, a systematic investigation of the general equilibria and dissolution/precipitation kinetics of chromium compounds in concentrated alkaline solutions is key to predicting the behavior and speciation of chromium in the Hanford tank systems.

Needs related to leach solution stability: Once chemical constituents have been leached from the waste, it must be ascertained that subsequent processing will not cause re-precipitation or gel formation. This question will be addressed mainly by the Environmental Simulation Program (ESP) chemical equilibrium software (OLI Systems, Inc., Morris Plains, NJ), but the applicability of this software for predicting the solubilities of chromium, aluminum, and other elements of concern in alkaline solutions of high ionic strength must be demonstrated by laboratory testing.

Needs related to physical properties of sludge: Information about the physical properties of sludge wastes is also incomplete. Knowledge of particle size distribution and particle density is required for the design of waste transfer systems (pipes and pumps) and to determine whether transfers of slurries can be completed as planned. Although some particle size distribution measurements have been made, the densities of the particles in the wastes are unknown. Furthermore, the role of particle agglomeration is only beginning to come to light; it is not known whether agglomerates will be broken up in pumps, nor whether disrupted agglomerates will re-form during pipeline

	<p>transport. Basic information is needed about the effect of turbulence, ionic strength, temperature, and other processing variables on agglomeration. The information could also be used in the future to select tank cleanup methods, including for example high velocity fluid shear-based technologies.</p> <p>Needs related to sludge transport: Additional work is advisable to determine the transportability characteristics of Hanford sludge wastes. The model use to estimate the required transport velocity and to predict the head pressure that will be developed has been adapted from other industries and has not been qualified on Hanford slurries. Tests to demonstrate the minimum required transport velocity for Hanford slurries would be beneficial. The transport model should be extended to incorporate theory associated with agglomeration and de-agglomeration.</p> <p>Despite pipeline plugging over many years at Hanford, the technologies for removing plugs are still not well developed. Although it should be possible, through adequate planning, to avoid plugging of lines during delivery of the wastes to the waste treatment plant, having reliable methods for removing sediments from pipelines can benefit the project by reducing the need for excessive conservatism. Additional and advanced technologies for unplugging pipelines should be demonstrated and characterized to improve overall project efficiency.</p> <p>Problem Background: Solids and gels may form in the Hanford tank waste under certain processing conditions. Transfer lines have been plugged when solids or gels inadvertently formed. Knowledge of the solubility envelope for the waste is necessary to avoid unwanted precipitation or gel formation in supernatants. Improvements in processing efficiency are expected if the retrieval, pipeline delivery and treatment plant processes are based on an understanding of the dissolution thermodynamics and kinetics rather than just empirical data. Water use and makeup chemical addition can also be reduced which, together with the improvement in efficiency, can reduce the amount of HLW glass produced. Knowledge of waste solubility is necessary to avoid unwanted precipitation or gel formation in supernatants and to recover from such events should they occur.</p> <p>The volume of the HLW fraction of the immobilized waste that is produced by the plant (i.e., the glass that must be stored in a deep geologic repository) would be driven to a large extent by the chromium and aluminum content of the waste feed, if they are not removed. If these two metals can be dissolved out of the primarily water-insoluble HLW feed, the volume of immobilized waste, and, therefore, the overall cost of the Project can be reduced substantially. The lack of adequate understanding of aluminum and chromium dissolution chemistry will lead to overly conservative (i.e. overly expensive) design of both the Phase 1 and Phase 2 plants.</p> <p>Similar needs: Need RL-WT091 deals with parallel issues for retrieval, delivery, and treatment of salt-type wastes.</p> <p>Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.02.02.01.02.01 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> Requirements related to leaching: A fundamental understanding of aluminum and chromium chemistry, including identification of the compounds of those elements that are present, shall be developed to support prediction of the solubility of those elements in Hanford tank systems and under the currently planned in-plant sludge washing conditions. The solubilities and dissolution rates of these components shall be quantified as functions of temperature, alkalinity, presence of oxidizers, etc. The test conditions shall match the</p>

	<p>planned process parameters, so that the relative efficiencies of various proposed removal strategies can be compared.</p> <p>In order to compare leaching strategies effectively, solubility data for other components of interest in the sludges shall also be obtained. These data will be used in the ESP chemical equilibrium model.</p> <p>During these studies, data shall also be obtained to determine the effect of the processes (especially oxidation processes for chromium removal) on organic complexants and solubilities of strontium and transuranic compounds.</p> <p><i>Requirements related to leach solution stability:</i> Solubility information for the major species expected in leach solutions shall be compiled in a form suitable for inclusion in ESP. The compilation shall include problem species such as aluminate, silicate, and chromium species. The work shall include literature reviews to identify what solubility data are missing and identify what experimental work is needed to provide the missing data.</p> <p><i>Requirements related to physical properties of sludge:</i> Information shall be obtained to demonstrate how the data obtained with a light-scattering particle size distribution instrument relates to the particle sizes actually present during transport of a slurry. Information shall be obtained to estimate the density of waste slurry particles under transport conditions. A correlation shall be developed to yield critical velocity and pressure drop for slurries containing agglomerated solids. The inputs to the correlation shall be measurable, calculable, or known.</p> <p><i>Requirements related to sludge transport:</i> Full-scale tests shall be performed with simulants to identify and/or confirm potential problem conditions. Pump rates will be about 140 gpm through 3" diameter lines.</p> <p>An empirical model (but with a strong foundation in theory) shall be developed to predict chemical adjustments required to support transport and settling operations. The model shall incorporate theory associated with agglomeration, sedimentation, and fluid dynamics. Dilution effects, including temperature reduction and solids dissolution/precipitation, shall also be included.</p> <p>This model shall utilize waste composition and operating conditions as its inputs. It shall provide a technical basis for pipeline transport specifications; such basis is currently deficient and may be over-restrictive. The model shall include a means for predicting the formation of solids and gas during pipeline transfer, and the physical properties of these inhomogeneities, such as particle (and bubble) sizes, shapes, and densities, and the relation of these properties to foam stability and plug formation. The model shall demonstrate dependence of the particulate properties on hydrodynamic conditions and history; this information would lead to calculations of sedimentation rate and transfer design parameters, such as critical flow velocity and head pressure. This tool shall also be able to predict the effect of blending different chemical waste types.</p>
***	<p><i>Schedule Requirements:</i> Physical property information about sludge wastes will continue to have value as systems and operations are designed to remove wastes from single shell tanks. Time and dollars can be saved by knowing how to translate laboratory measurements of waste characteristics into predictions of retrieval efficiencies and other measures of operational performance.</p> <p>Leachability information supports the SST retrieval sequence analysis. The retrieval sequence analysis will provide the foundation for Phase 2 planning, and meets Tri-Party Agreement Interim Milestones M-45-02D</p>

	<p>through M-45-02I (annual updates of the SST Retrieval Sequence document). Information about waste leachability obtained through FY04 may be incorporated in the equipment design and operating plans of the waste treatment plant.</p> <p>All information developed in response to this site need will have use in improving process operations throughout the life of the project (>20 yr). However, information available before the treatment plant equipment design and processes are finalized will produce the largest cost savings. For the Phase 1 (pilot) facility, this is in the 0-to-2-year time frame; for Phase 2, this is in the 10-to-20-year range.</p>
14	<p><i>Definition of Solution:</i> This site need will have been met when the chemical and physical characteristics of Hanford's sludge wastes are known well enough that the costs for retrieving and delivering those wastes to the WTP can be predicted to within 20%.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> A significant cost avoidance is expected if line plugging or problems with flow capacity can be avoided. Plugs are expensive to remove or repair (~\$1M per occurrence), but more serious is the likelihood of plant downtimes of several weeks or months. Programmatic delays may cause violation of the Tri-Party Agreement (see below), resulting in substantial financial penalties, and jeopardize viability of the Project.</p> <p>Better knowledge of plugging potential and of operational conditions that avoid plugging may permit loosening of overly restrictive process control requirements. This would reduce waste volume and programmatic time and costs.</p> <p>Completion of the leach-testing strategy supports retrieval sequence development and broadens the technical foundation that is needed for planning Phase 2. This will result in better separations at less cost, producing a lower volume of final immobilized waste form.</p> <p>A significant waste volume reduction and concomitant cost avoidance is expected during Phase 1 if the sludge washing process for aluminum can be optimized. Removal of aluminum will produce additional savings during Phase 2, but a much greater cost avoidance is expected if chromium can be removed effectively from the sludge in Phase 2.</p>
17 *	<p><i>Potential Cost Savings:</i> Pluggage avoidance: \$2M/yr Canister cost avoidance: \$6,000 M</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> The pluggage avoidance estimate is based on an estimate of two plugs per year and an estimate of \$1M to remove the plug and recover from its effects. This does not include additional costs that that could be incurred to schedule slippage. The number of plugs that occur each year is extremely variable, depending on the types of operations being conducted and the frequency of each (experience factor).</p> <p>The canister cost avoidance is difficult to calculate because the leachability of chromium may be in error by a factor of two. The estimate given is based on the current estimate that HLW will fill 12,500 canisters, and that, if all the chromium could be removed, about 3000 canisters could be avoided. The cost of making and disposing of a single canister is estimated to be \$2M. Despite the vagaries of this estimate, the possible cost savings are certainly large.</p>
***	<p><i>Technical Basis:</i> This effort will provide a basis for feed delivery and treatment operations during Phase 1B. The current state of knowledge is insufficient to predict, in all cases, whether planned transfers are feasible, whether leaching will achieve waste minimization goals, or whether unplanned solids precipitation may occur during processing in the waste treatment plant.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Long-term disposal of the high-level wastes stored in Hanford's</p>

	underground tanks is a national priority. The DOE has a legal agreement (the Tri-Party Agreement) with the Environmental Protection Agency and the State of Washington Department of Ecology to dispose of the waste according to a stated schedule. Native American tribal interests and a number of public interest groups monitor adherence to this agreement. Program delays due to inability to retrieve and deliver waste feeds containing solids may violate the Tri-Party Agreement.
20	<i>Environment, Safety, and Health Basis:</i> Without this work, plugging of lines is more likely. Recovery from pipe plugging incidents normally involves exposure of personnel to ionizing radiation beyond planned levels.
21	<i>Regulatory Drivers:</i> Tri-Party Agreement
22*	<i>Milestones:</i> Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," , due at the end of each fiscal year.
23*	<i>Material Streams:</i> Hanford high-level defense waste
24*	<i>TSD System:</i> Double Shell Tank System and Single Shell Tank System
25	<i>Major Contaminants:</i> Fission products, actinides, nitrate. 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	<i>Contaminated Media:</i> N/A. This project addresses wastes in engineered containment.
27	<i>Volume/Size of Contaminated Media:</i> There are 54 million gallons (204 dam ³) of Hanford sludge and saltcake wastes stored in underground tanks. [Ref: B. M. Hanlon, "Waste Tank Summary Report for Month Ending July 31, 2001," HNF-EP-0182, Rev. 160, (CH2M HILL Hanford Group, Inc., Richland, WA, September 2001).]
28 *	<i>Earliest Date Required:</i> FY 2002
29 *	<i>Latest Date Required:</i> 2020
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Process testing with actual waste samples is now used to obtain needed data; these tests are not extensive and do not indicate quantitatively how leachability may be affected by process variable, such as temperature and time. The ESP software is used in conjunction with the process tests; ESP has been only partially validated with actual waste solubility data. ESP does not provide physical property data. Technology Insertion Point(s): N/A
31	<i>Life-Cycle Cost Using Baseline:</i> Activities 150.B22, "Maintain the Operations & Utilization Plan," and 120.025, "Maintain WFD Technical Basis," will make use of the data provided under this site need. Funds allocated for these activities are \$1.2M in FY2002, about the same each year through FY2018. Several activities provide funding for limited laboratory characterization of sludge wastes. Activities 160.S10, 120.B20, and 120.R10 provide \$0.6M in FY2002, and similar activities provide \$1.1M in FY2003, \$0.8M in FY2004, and \$0.4M in FY2005. Life Cycle Costs related to Sludge retrieval and transfer to the treatment plant are estimated at \$4-8 Billion. This includes equipment, operations, maintenance and infrastructure upgrades over time, but does not include "closure".
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> Unknown
33	<i>Completion Date Using Baseline:</i> Activities, "Maintain the Operations & Utilization Plan," and "Maintain WFD Technical Basis," are planned to continue throughout the life of the project. The laboratory characterization activities will complete in FY2006. The RPP is scheduled to complete

	post 2020.
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> J. R. (Jim) Jewett, NHC, 509-373-1228, fax 509-372-0065, James_R_Jewett@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36 **	<i>Other Contacts:</i> R.D. (Richard) Wojtasek, CHG, 509-376-7000, fax 509-372-3983, Richard_D_Wojtasek@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov N.W. (Nicholas) Kirch, CHG, 509-373-2380, fax 509-373-4641, Nicholas_W_Nick_Kirch@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG.

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Chemical and Physical Behavior of Saltcake Wastes
2 *	<i>Need Code:</i> RL-WT091
3 *	<i>Need Summary:</i> Provide additional equilibrium and kinetic solubility data to guide the retrieval, delivery, and treatment of Hanford tank saltcake wastes.
4 *	<i>Origination Date:</i> November 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No.:</i> RL-TW04
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms. <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs <p>SSTs in a ready state for implementing closure and final disposal of the SST farms.</p>
12	<i>Need/Problem Description:</i> Wastes must be transported and treated with minimum cost and delay. To this end, the transfer and treatment equipment must be designed correctly, and the operating plans must be accurate. Successful planning, equipment design, and plant operation all rely on accurate knowledge of the chemistry and physical properties of the wastes to be treated. In particular, detailed knowledge of waste component solubilities permits planning to take place to

ensure that production expectations are achieved.

Although a good deal of information has been obtained about the elemental composition of the waste, we do not yet have complete knowledge of the chemical compounds and mineralogy formed by these elements. Accurate knowledge of the chemical compounds present in saltcake wastes is important to predict how much of the waste will dissolve as a function of the amount of dilution water added, temperature, and other process parameters.

The chemical equilibrium software package Environmental Simulation Program (ESP; OLI Systems, Inc., Morris Plains, NJ) is used on the Hanford Site to calculate the amounts of each waste component in the solid and liquid phases of partially dissolved saltcakes. However, these calculations are very challenging for the software because of the many species present in the waste; the high ionic strengths of typical Hanford wastes also strain the reliability of these calculations. Therefore, equilibria must be measured with actual wastes under expected process conditions to verify ESP calculations and to correct any deviations that are discovered. A systematic study should be made to identify ESP shortcomings, determine the data required to correct them, determine whether the data already exists (in the open literature or in DOE-sponsored reports), and organize and perform an efficient laboratory test program to obtain missing data.

Saltcake transfers are expected to occur at a nominal sodium concentration of 5M, so the possibility of a pipe plugging during a saltcake waste transfer is very low. However, unusual processing scenarios, such as a pump failure during cold weather may lead to situations where solid phase formation could occur. ESP should be able to predict solid formation (insofar as the process conditions, such as pipe temperature, can be predicted). However, ESP will not (directly) predict the physical form of the solids, which may range from gel or sludge to large, pipe-filling crystals, depending on the chemical composition, cool-down rate, and other such factors. Information about the physical form of solids that may be expected is needed to plan for recovering from such process upsets. This information will also be useful in other tank farm programs, such as Interim Stabilization (saltwell pumping).

Studies to date show that there can be sizable portions of nominally soluble species such as sodium ion or cesium ion that remains in solids after extensive water contact. The form that these soluble species exist in should be explored and suggested methods to retrieve these should be tried.

The waste contains sparingly soluble salts such as sodium oxalate, sodium sulfate, and certain double salts such as sodium fluoride phosphate. These sparingly soluble salts may limit the effectiveness of simple water additions to dissolve the salt cake. An understanding of the effect of ionic strength and common ion effects need to be developed. There is also a concern with these sparingly soluble salts that they may be dissolved at one location in the salt bed and then reprecipitated in another portion in the salt bed. Another issue is post transfer precipitation in the receiving tank.

Problem Background: Solids and gels may form in the Hanford tank waste under certain processing conditions. Transfer lines have been plugged when solids or gels inadvertently formed. Knowledge of the solubility envelope for the waste is necessary to avoid unwanted precipitation or gel formation in supernatants. Improvements in processing efficiency are expected if the retrieval, pipeline delivery and treatment plant processes are based on an understanding of the dissolution thermodynamics and kinetics rather than just empirical data. Water use and makeup

	<p>chemical addition can also be reduced which, together with the improvement in efficiency, can reduce the amount of glass produced. Knowledge of waste solubility is necessary to avoid unwanted precipitation or gel formation in supernatants and to recover from such events should they occur.</p> <p>Similar needs: Need RL-WT090 deals with parallel issues for retrieval, delivery, and treatment of sludge-type wastes.</p> <p>Program Baseline Summary (PBS) No.: TW04 *** Work Breakdown Structure (WBS) No.: 5.02.02.01.02.01 *** TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> Solubility information for the major species expected in leach solutions shall be compiled in a form suitable for inclusion in the Environmental Simulation Program (ESP; a product of OLI Systems, Inc., Morris Plains, NJ), which is in use at the Hanford Site. The compilation shall include the major constituents, sodium and potassium salts of nitrate, nitrite, and hydroxide; important species aluminate, silicate, sulfate, carbonate, phosphate, fluoride, chloride, and chromium; and important radionuclides, including ^{60}Co, $^{89/90}\text{Sr}$, ^{99}Tc, ^{125}Sb, ^{137}Cs, ^{154}Eu, ^{155}Eu, ^{241}Am, ^{238}Pu, ^{239}Pu, and ^{240}Pu. The work shall include literature reviews to identify what solubility data are missing and identify what experimental work is needed to provide the missing data.</p>
***	<p><i>Schedule Requirements:</i> Solubility information obtained in answer to this need will support the SST retrieval sequence analysis, which is updated annually throughout the life of the project, in accordance with Tri-Party Agreement Interim Milestones M-45-02D through M-45-02I.</p>
14	<p><i>Definition of Solution:</i></p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> The main benefit of these activities will be to improve the reliability to retrieve, stage, and transfer low-activity waste feeds. Without this information, production expectations may not be met because of unexpectedly low waste solubility.</p> <p>An additional benefit is to improve planning for actions to recover from operational upsets. Better knowledge of plugging potential and of operational conditions that avoid plugging may permit loosening of overly restrictive process control requirements. This would reduce waste volume and programmatic time and costs.</p>
17 *	<p><i>Potential Cost Savings:</i></p>
18 *	<p><i>Potential Cost Savings Narrative:</i></p>
***	<p><i>Technical Basis:</i> This effort will provide a basis for feed delivery and treatment operations. The current state of knowledge is insufficient to predict, in all cases, what waste compositions and operating conditions will produce solids, and, if those solids form, whether they will be of such a nature as to result in pipe plugging.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Long-term disposal of the high-level wastes stored in Hanford's underground tanks is a national priority. The DOE has a legal agreement (the Tri-Party Agreement) with the Environmental Protection Agency and the State of Washington Department of Ecology to dispose of the waste according to a stated schedule. Adherence to this agreement is monitored by Native American tribal interests and a number of public interest groups. Program delays due to inability to retrieve and deliver waste feeds containing solids may violate the Tri-Party Agreement.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> Completion of this work will make retrieval and delivery</p>

	predictions more reliable, improving the reliability of the delivery sequence. These program improvements will decrease the possibility of programmatic delays, so that waste can be moved to safe storage as soon as possible.
21	<i>Regulatory Drivers:</i> Tri-Party Agreement. This need supports the regulatory requirements for storage and transfer of waste.
22 *	<i>Milestones:</i> Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," 9/30/2000 and annually thereafter.
23 *	<i>Material Streams:</i> Hanford high-level defense waste. Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank Systems and Single Shell Tank Systems
25	<i>Major Contaminants:</i> Fission products, actinides, nitrate. 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	<i>Contaminated Media:</i> N/A. This project addresses wastes in engineered containment.
27	<i>Volume/Size of Contaminated Media:</i> 204,400 m ³ . See R. A. Kirkbride, "Tank Farm Contractor Operation and Utilization Plan," HNF-SD-WM-SP-012, Rev. 2, p. "Summary-3," (CH2M HILL Hanford Group, Inc., Richland, WA, April 19, 2000). For details, see, e.g., B. M. Hanlon, "Waste Tank Summary Report for Month Ending June 30, 2000," HNF-EP-0182-147, (CH2M HILL Hanford Group, Inc., Richland, WA, August 2000).
28 *	<i>Earliest Date Required:</i> January 2001
29 *	<i>Latest Date Required:</i> FY 2020
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> A thermodynamic model known as the Environmental Simulation Program (ESP) is used in conjunction with the process tests. The ESP has been only partially validated with actual waste solubility data. <i>Technology Insertion Point(s):</i> N/A
31	<i>Life-Cycle Cost Using Baseline:</i> Activities 150.B22, "Maintain the Operations & Utilization Plan," and 120.025, "Maintain WFD Technical Basis," will make use of the data provided under this site need. Funds allocated for these activities are \$3.1M in FY01 and \$2.8M in FY02. Several activities provide funding for limited laboratory characterization of sludge wastes. Activities 120.V10 and 120.L10 provide \$390K in FY01, and activities 120.R10 and 120.T10 provide the same amount in FY02. Life Cycle Costs related to Salt retrieval and transfer to the treatment plant are estimated at \$10-20 Billion. This includes equipment, operations, maintenance and infrastructure upgrades over time, but does not include "closure".
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> Unknown
33	<i>Completion Date Using Baseline:</i> Activities, "Maintain the Operations & Utilization Plan," and "Maintain WFD Technical Basis," are planned to continue throughout the life of the project. The RPP is scheduled to complete post 2020.
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.A. (Dan) Reynolds, CHG, 509-373-3115, F/509-373-4641 Daniel_A_Reynolds@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov

36 ***	<i>Other Contacts:</i> A. F. (Anne-Marie) Choho, CHG, 509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov
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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG.

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Separable Organic Phase Destruction, Removal, and Monitoring In Tank Waste
2 *	<i>Need Code:</i> RL-WT103
3 *	<p><i>Need Summary:</i> The Hanford Site used organic solvent extraction processes for the recovery of plutonium, uranium and fission products. The separable organic material included normal paraffin hydrocarbon (NPH), tributyl phosphate (TBP), bis-di-2-ethyl hexyl phosphoric acid, and hexone. Although it was not a routine practice to discharge organic material to waste tanks, an uncertain amount of separable organic material was discharged to the tank farms at Hanford. As of December 2000, one single-shell tank (SST), C-103, is known to contain about 4,500 gallons of floating separable phase organic liquid comprised of TBP and NPH. Four other SSTs have been identified as containing lesser volumes of TBP and/or NPH entrained in the waste solids. In the past, there was evidence that some DSTs likely contained separable organic material, however, there is no current evidence of a separate organic phase in any of Hanford's twenty-eight DSTs.</p> <p>The River Protection Project mission includes removal of the pumpable liquids from SSTs (interim stabilization) by FY 2004 and processing of tank waste at a Waste Treatment Plant (WTP) by FY 2007. Currently, a 25-ppm separable organic material limit has been imposed on WTP waste feed. It has been suggested that trace concentrations of separable organic material entrained in waste solids can be processed in the WTP with minimal impacts. The baseline plan for interim stabilization of C-103 has the floating separable organic layer and the aqueous liquid being pumped together to a designated DST. An alternative process for separately removing the organic layer prior to waste transfer from C-103 to the receiver DST has been evaluated and found to be viable but not cost effective.</p> <p>Technology development can aid the handling of the C-103 organic layer and any other separable organic material that may be discovered during waste retrieval in support of WTP processing. Specifically, technology that could remove the C-103 organic layer down to the 25-ppm level, without entrainment of the radiologically-contaminated aqueous liquid could make that alternative cost effective. Currently available technology, such as floating weir skimmer pumps or continuous belt skimmers have been proposed but have not been shown to meet all criteria identified in the "Separable Organic Management Strategy" (Memo, CHG-0004873 R2, B. R. Estey (CHG) to J. J. Short (DOE-ORP), "Contract Number DE-AC27-99RL14047: Submittal of Separable Organic Management Strategy White Paper," dated November 17, 2000).</p> <p>Technology development is also needed for an alternative that would capture the separable organic material in the solid phase and retain it there through retrieval and waste processing. A proposed technology for this capability includes absorbing the organic on solid carbon, which would be retained with the waste solids.</p> <p>Technology development is also needed for an in-tank process to degrade the separable organic material. It has been observed that contact with high concentrations of hydroxide degrades TBP, the principal remaining separable organic material, to aqueous-soluble organic compounds. This process occurs very slowly if there is no mixing of the high hydroxide aqueous layer with the separable organic layer. Other in-tank methods for organic destruction should be proposed and evaluated.</p> <p>A final technology development need involves detection of floating organic material in DSTs. The</p>

	WTP feed limit of 25 ppm represents approximately 25-gallons in a 1,000,000-gallon waste tank. A 25-gallon layer of separable organic material across the waste surface is approximately 0.01 inch thick. Detection of this small volume is not currently achievable in Hanford waste tanks.
4 **	<i>Origination Date:</i> FY 2001
5 **	<i>Need Type:</i> Technology Opportunity
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8	<i>Project:</i> Retrieval PBS No: ORP-TW04
9	<i>National Priority:</i> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The Single-Shell Tank (SST) Interim Closure Project is responsible for Program/Project Planning and Execution; Environment, Safety, Health, and Quality Assurance; Facility Operations; Engineering; Maintenance; Interim Stabilization; and Technology Development, Demonstrations, and Deployments necessary for the safe and cost effective storage, retrieval, immobilization, and closure of SST wastes, associated underground storage tanks, and ancillary piping and equipment. Safe storage of wastes includes day-to-day operations of the SST's and saltwell pumping operations to remove pumpable liquids from the SST's for transfer to double-shell tanks (DST's) to achieve interim stabilization and minimize the potential for SST leakage. Retrieval projects will be conducted to remove wastes from SST's for placement in DST's in support of waste feed delivery to the Waste Treatment Plant and eventual waste immobilization. An integral part of SST waste retrieval operations is leak detection, monitoring, and mitigation. Safe storage, retrieval, and closure activities associated with SST wastes are also supported by Special Projects and Vadose Zone Projects to characterize groundwater flow and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes.
12	<i>Need/Problem Description:</i> The WTP can accommodate trace quantities of separable organic material (<25ppm waste feed limit). No measurable effect is expected in the WTP Process or in glass product quality from trace quantities of separable organic material. In larger quantities, the separable organic material could cause degradation of the elastomer seals on retrieval pumps and the ethylene-propylene-diene-monomer (EPDM) type hoses. Separable organic material could also plug pretreatment filters requiring frequent back flushing and extra cleaning of the filters with special solutions and techniques. Separable organic material could coat the surfaces of ion exchange resins and reduce the cesium loading capacity. Finally, separable organic material could cause flammable gas concerns in the off-gas and vessel ventilation systems in the vitrification process for low-activity waste and high-level waste.
***	Program Baseline Summary (PBS) No.: TW04
***	Work Breakdown Structure (WBS) No.: 5.01.04.02.04.01.01, 5.01.04.02.04.04

***	TIP No.:
13	<p><i>Functional Performance Requirements:</i> The separable organic material destruction, separation, or detection technology needs to be able to address organic concentrations <25 ppm. The O&M Contractor has estimated that as much as 250 gallons of NPH could be evaporated in less than two months from a tank ventilated at a rate of 150 scfm at a temperature of 40 degrees centigrade. Using this value and assuming a mixing ratio of NPH:TBP of 2:1, it would take a few years to evaporate the NPH fraction of the organic in C-103.</p> <p>A preliminary model was developed for predicting time requirements for alkaline hydrolysis of TBP at several different conditions. For the 4,500 gallons of separable organic material in C-103, it has been predicted that with an aqueous to organic ratio of 20, 0.5M hydroxide solution, and a temperature of 50 degrees centigrade, it would take 1.5 years to degrade 99.95% of the TBP. In a similar prediction at 40 degrees centigrade, it would take 4 years to degrade 99.95% of the TBP.</p>
***	<p><i>Schedule Requirements:</i> Interim stabilization of tank 241-C-103 must be completed by FY 2004 per Hanford Consent Decree.</p>
14	<p><i>Definition of Solution:</i></p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i></p>
17 *	<p><i>Potential Cost Savings:</i> On the order of \$10 Million</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Construction and installation of separable organic material removal and treatment options has a high capital cost. The cost of removing and treating the separable organic layer in C-103 alone has been estimated at \$8.8 to \$9.8 Million.</p>
***	<p><i>Technical Basis:</i> As much as 2,490,000 liters (657,900 gallons) of separable organic material (TBP and NPH) was discharged to the Hanford tank farms over the operational period of the PUREX Plant. Much of the organic solvent has degraded, evaporated to the atmosphere, or was sent to condensate cribs. Current estimates suggest that from 34,000 liters (9,000 gallons) to 148,000 liters (39,000 gallons) of separable organic may still reside in tank wastes. This organic material may exist as a separate floating phase (continuous layer, pools, puddles, or sheen); emulsified droplets in the aqueous supernatant; and/or trapped or sorbed phases in the saltcake and sludge solids.</p> <p>There is evidence to suggest that most SSTs contain at least some organic material that is TBP or its degradation products. In many cases, the organic material appears to be trapped in the solid saltcake and sludge layers. Organic material released from solid phase layers during retrieval could remobilize to form a separate bulk phase that floats on the surface of the aqueous tank waste, if NPH is present. Analyses of gases within tank vapor spaces suggest that the SSTs contain a similar family of volatile organic compounds that would be expected as degradation products of TBP and NPH. Other direct and indirect evidence suggests that the occurrence of separable organic material may be a more global problem throughout the Tank Farm Complex at Hanford.</p> <p>The principle insoluble organic material suspected in the Tank Farms is a mixture of NPH and TBP. NPH is a straight-chained hydrocarbon with very low solubility in aqueous solutions. NPH forms immiscible phases in the presence of aqueous tank waste solutions.</p> <p>TBP and its degradation products are soluble, to varying degrees, in aqueous solutions and are typically found in many of Hanford's SSTs and DSTs. TBP is highly soluble in NPH. When associated with NPH, TBP does not dissociate into the aqueous phase and is armored against</p>

	chemical hydrolysis. The mixture of TBP and NPH is less dense (0.876 gram/milliliter) than the aqueous tank waste. As a result, the mixture of TBP and NPH tends to float to the top of the aqueous wastes by gravity separation.
19	<i>Cultural/Stakeholder Basis:</i> Reviewers for DOE (Tank Advisory Panel – Chemical Reactions Subpanel), Washington State Department of Ecology, and other stakeholders have expressed concerns with saltwell pumping the organic and aqueous phases from SSTs to DSTs during interim stabilization operations.
20	<i>Environment, Safety, and Health Basis:</i> Safety is a moderate to strong discriminator for decisions regarding the handling of separable organic phases in tank wastes. All technological options will require an Unreviewed Safety Question (USQ) evaluation against the existing nuclear safety authorization basis (AB). Subsequent to a positive USQ determination, the AB would be changed to include the new technological option for implementation. The USQ determination activities associated with removal and treatment options will be extensive due to significant worker doses resulting from the handling of mixed organic and aqueous phases. Shielding and administrative controls will be required to assure conformance to the ALARA policy. Technological options for addressing the separable organic material will likely require special regulatory reviews and environmental permits.
21	<i>Regulatory Drivers:</i> Issues surrounding separable organic phases in SSTs must be resolved to avoid potential impacts to the Hanford Site Consent Decree for interim stabilization (saltwell pumping) of all SSTs by fiscal year 2004.
22 *	<i>Milestones:</i> TBD
23 *	<i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Saltcake, Sludge, Supernatant. Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> Estimated 39,000 gallons of separable organic in tank wastes. 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 *	<i>Earliest Date Required:</i> September 2001
29 *	<i>Latest Date Required:</i> September 2003 (to support FY 2004 completion of C-103 interim stabilization)
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> There are several basic options to address the global concern of separable organic material in tank wastes. All options are challenged by the ability to detect a separable organic phase. Indirect methods for addressing the separable organic material include in-tank evaporation and alkaline hydrolysis. Several direct methods are available and represent various locations where separable organic material might be encountered and dispositioned. These include: (1) Remove and treat the separable organic material from each SST before retrieval, (2) Remove and treat the separable organic material during SST retrieval operations, (3) Remove and treat the separable organic material from each DST, (4) Consolidate the separable organic material in a single DST, (5) Remove the separable organic material during waste transfer to the WTP, and (6) Treat the separable organic material in the WTP.

	Technology Insertion Point(s): N/A
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i> post 2020 for all SSTs/DSTs
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> W. B. (Blaine) Barton, CHG, 509-376-5118, F/509-373-4641, W B Blaine Barton@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov
36 ***	<i>Other Contacts:</i> J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-0605, Jerry W Cammann@rl.gov A. F. (Anne-Marie) Choho, CHG, 509-372-8280, F/509-373-6382, Anne-Marie F Choho@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Chemical Dissolution of Water Insoluble Wastes from Single Shell Tanks (SSTs)
2 *	<i>Need Code:</i> RL-WT112
3 *	<i>Need Summary:</i> The low volume density gradient method of retrieval from the SSTs is currently only applicable to the soluble salts in the tanks. Essentially all tanks contain some insoluble material. Chemical methods are needed to dissolve and retrieve the insoluble material that will remain after the soluble salts are recovered. The methods must be compatible with carbon steel tanks.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No:</i> RL-TW04
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the SSTs SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<i>Need/Problem Description:</i> The tank wastes have a varied chemistry. The majority of the waste is various salts of sodium and potassium stored on a wet, high caustic environment. However, much of the waste is in the form of sodium aluminum silicates and metal hydroxides, predominantly iron. These materials are stored in carbon steel tanks. The current plan envisions dissolving the soluble salts in water and pumping them from the tanks. This will leave behind the aluminum silicates and metal hydroxides. A chemical cocktail(s) is desired that will dissolve the remaining materials in the tank without significantly attacking the tank walls. It is desired that the dissolution can take place under conditions of short contact time, i.e., hours rather than weeks, and low mechanical agitation. The resulting stream must be compatible with pumped transfer and

	<p>extended storage in carbon steel tanks. The chemical cocktail should be able to be destroyed with little residue in downstream processes. If released to the environment, the chemicals should breakdown so as not to present a long-term radionuclide mobility challenge in the Hanford soils. Because the receiving tank space is limited, it is desired that the chemical cocktail be able to retrieve the waste at concentrations of waste greater than 0.5 molar. Lower concentrations will be evaluated on an economic feasibility basis.</p> <p>It is envisioned that organic complexants will be used to dissolve the water insoluble waste discussed above. The complexants would exceed the Waste Treatment Plant feed specification for total organic carbon. It will be necessary to destroy these complexants before the wastes are sent to the Waste Treatment Plant. This task would identify a recommended technology to be used to destroy the organics. In addition it will perform any necessary development to allow DOE to procure the process for deployment in the tank farms. EM-50 did some development work on a broad selection of organic destruction technologies in the early 1990s. This could be a good starting point to select a preferred technology. The tank farm contractor will provide the detailed listing of requirements of the system.</p> <p>Nuclear criticality safety currently requires that the solids particle size in waste disposed to RPP be demonstrably less than 10 μm. The requirement is based solely on hydrodynamics and was instituted because insufficient data exist on the actual distribution of plutonium to sludge-forming elements (e.g., iron, chromium, aluminum, and manganese) in actual HLW. Conversely, plutonium potentially can segregate from neutronic poisons present in current HLW by chemical mechanisms through HLW blending or retrieval operations, and thus constrain present or planned process operations. Information should be developed to insure that deployment of the above processes would not result in segregation of plutonium.</p> <p><i>Consequence of Not Filling Need:</i> In the event that no satisfactory cocktail can be found the insoluble wastes will be retrieved by slurry or mechanical techniques at a significant cost penalty to the project. These methods are cost prohibitive for small volumes of waste residue remaining after saltcake dissolution.</p> <p>*** Program Baseline Summary (PBS) No.: TW04 *** Work Breakdown Structure (WBS) No.: 5.02.01.01.01 *** TIP No.:</p>
13	<i>Functional Performance Requirements:</i>
	*** <i>Schedule Requirements:</i>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$5-40 million per tank
18 *	<i>Potential Cost Savings Narrative:</i> Current planning shows a cost of ~\$30 million to retrieve saltcake tank, \$40 million for tanks with mixed saltcake and sludge, and \$77 million to retrieve sludge tanks. The use of a solution mining technique allows for a simplified mechanical system which could significantly reduce the cost of any of these waste retrieval activities. It is expected that a single organic destruction system would be required which when pro rated across the tanks would still result in significant savings to the baseline.
	*** <i>Technical Basis:</i>

19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> This technology would be deployed in SST retrieval as soon as it become available. The next opportunity occurs in 2002 with additional tanks being retrieved for more then 20 years thereafter.
23 *	<i>Material Streams:</i> Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> Pu-238, -239, -240, -241; Am-241; U-238; C-14; Ni-59/63; Nb-94; Tc-99; I-129; Cm-242; Cs-137, Sr-90, , Sn-126; Se-79; chromium; nitrate; nitrite; complexants (EDTA/HEDTA).
26	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge. For details, see, e.g., B. M Hanlon, "Waste Tank Summary Report for Month Ending June 30, 2001," HNF-EP-0182, Rev. 159, (CH2M HILL Hanford Group, Inc., Richland, WA, July 2001).
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> October 2002
29 *	<i>Latest Date Required:</i> ~FY 2020
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> <i>Technology Insertion Point(s):</i>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> W. B. (Blaine) Barton, CHG, 509-376-5118, F/509-373-4641, W B Blaine Barton@rl.gov
35	<i>DOE End User POCs:</i> E. J. (Joe) Cruz, DOE-ORP, 509-372-2606; F/509-373-1313; E J Cruz@rl.gov
36**	<i>Other Contacts:</i> A. F. (Anne-Marie) Choho, 509-372-8280, F/509-373-6382, Anne-Marie F Choho@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov

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**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1*	<i>Need Title:</i> Selective Species Removal
2*	<i>Need Code:</i> RL-WT113
3*	<i>Need Summary:</i> Certain chemicals are a problem when making glass because they do not enter the glass form easily or produce poor quality of glass. While the main responsibility for glass making and waste pre-treatment is with WTP, there may exist an opportunity for the tank farms to do some in-tank processes that may assist WTP.
4*	<i>Origination Date:</i> November 2001
5*	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8*	<i>Project:</i> Retrieval and Disposal <i>PBS No.:</i> RL-TW04 and RL-TW09
9*	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer DST Waste function is to provide feed to the Waste Treatment Plant (WTP) and receive waste from SSTs. A primary objective of this function is to provide the tank farm infrastructure necessary to deliver waste to the WTP within established specifications. The baseline end state of the Retrieve and Transfer DST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the DSTs • The safe, environmentally compliant transfer of this waste to the WTP • DSTs in a ready state for implementing closure and final disposal of the DST farms. <p>The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<i>Need/Problem Description:</i> There are certain chemical species in the SST and DST waste that are difficult for the WTP to deal with because of difficulties with getting these chemical species incorporated in to the glass matrix.

	<p>If these can be removed or controlled in the tank farms then there is a potential for large savings. The chemical species are sulfur, Tc-99, Sr-90 in complexant waste, and I-129.</p> <p>There has been a suggested method to remove sulfate from the waste by a selective precipitation method. This or other methods should be looked at to see if it is cost effective to implement in the tank farms. This may allow for fewer additives in the glass formulation to compensate for the amount of sulfur in the wastes.</p> <p>Technetium-99 should go to the HLW waste stream. However, much of the Tc-99 in the waste is in the soluble pertechnetate form. If Tc-99 could be moved to another valence state, then the Tc-99 would form an insoluble mineral that would move with the solids to the HLW waste stream. Much of the Tc-99 in the tank farms is not in the pertechnetate form and has shown to be difficult to leach.</p> <p>The complexants in complexed waste hold the Sr-90 in solution. A permanganate precipitation step is currently utilized in the WTP head end to remove this Sr-90. If this could be done in the tank farm, it may be cheaper than in the WTP pretreatment.</p> <p>Iodine is another element that a change in valence state may be all that is necessary to remove it from the liquid portion of the waste. Much of the iodine is in the solids as iodates but enough remains in the liquids as iodide to potential bother WTP processing. If there is a simple method for removing the iodine by perhaps changing the valence state to an iodate, then there may be one less stream at WTP with a problem.</p> <p>Selective removal of these constituents could be accomplished for the SST wastes as part of the SST retrieval operation before entry into the DSTs, by processing DST waste and returning it to the DSTs, or as part of the transfer process from the DSTs to the WTP.</p> <p>Program Baseline Summary (PBS) No.: TW04 and TW09 Work Breakdown Structure (WBS) No.: 5.02.01.01.01 TIP No.: The need can be met as early as 2005 or as late as 2020.</p>
13	<i>Functional Performance Requirements:</i>
	<p>Schedule Requirements: The need can be met as early as 2005 or as late as 2020</p>
14	<i>Definition of Solution:</i>
15*	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i> Performing these operations in the tank farm may be more cost effective than doing so in WTP. There may also be a schedule improvement with these activities.
17*	<i>Potential Cost Savings:</i> \$5,000,000
18*	<i>Potential Cost Savings Narrative:</i> If these chemical species can be put in the waste stream that is most appropriate for disposal to WTP in the tank farms, then treatment in WTP will not be necessary. Even if WTP is constructed with capabilities to treat these species, not having to run WTP process is a cost savings.
**	<i>Technical Basis:</i> The species listed here are problematic for the WTP and/or tank closure. If these species can be removed or at least controlled then more flexibility is available for feed delivery. If these species can be disposed of without going to WTP then there is a rather large potential cost savings. The chemistry for these species is reasonably well understood but it needs to have a process defined and demonstrated for tank farm operations.

19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22*	<i>Milestones:</i> There are currently no milestones that these activities would directly affect. However, a proven technology would allow changes in the baseline operations at Hanford.
23*	<i>Material Streams:</i> Hanford high-level defense waste. TW03 - Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tank and Single Shell Tank systems
25	<i>Major Contaminants:</i> Pu-238, 239, 240, 241; AM-241; U-238; C-14; Nt-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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28*	<i>Earliest Date Required:</i> FY 2005
29*	<i>Latest Date Required:</i> FY 2020
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point: The need can be met as early as 2005 or as late as 2020.
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.A. (Dan) Reynolds, CHG, 509-373-3115, F/509-373-4641 Daniel_A_Reynolds@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36**	<i>Other Contacts:</i> A. F. (Anne-Marie) Choho, CHG, 509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Technology to Support Post-Retrieval Evaluation of SSTs
2 *	<i>Need Code:</i> RL-WT115
3 *	<i>Need Summary:</i> An accurate technology or methodology to evaluate tank contents remaining before, during and after retrieval and transfer is needed. This will meet the new requirements listed in Appendix H of the TPA.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval and Closure PBS No: RL-TW04, RL-TW11
9 *	<i>National Priority:</i> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the SSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms. <p>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.</p>
12	<i>Need/Problem Description:</i> To measure whether TPA goals (550 curies of mobile long lived radioisotopes, 99% of tank contents for Tank S-112) have been met, SST Retrieval projects need a

	<p>technology or methodology to evaluate tank contents remaining before, during and after retrieval.</p> <p>To evaluate the performance of the retrieval, the amount of the waste in the tank before retrieval may be determined. This volume determination will also allow a comparison with the estimation from the Best-Basis Inventory.</p> <p>During retrieval, the technology or methodology will be used to perform a volumetric analysis of the amount of waste removed from the tank and can be used in support of the determination of the most accurate mass balance.</p> <p>Eventually, the system will be used to determine residual tank waste volume to measure whether TPA waste volume retrieval goals have been met.</p> <p>In addition to measuring against TPA goals, the SST retrieval program's near term projects are tasked with improvement upon the baseline retrieval technology of past practice sluicing. The TMS could be used develop waste retrieval efficiency and cost profiles for the various alternative retrieval technologies. This will assist in out-year planning and address the challenges of funding the baseline scope.</p> <p>*** Program Baseline Summary (PBS) No.: TW04, TW11 *** Work Breakdown Structure (WBS) No.: 5.02.01.01.01 *** TIP No.:</p>
13	<i>Functional Performance Requirements:</i>
***	<i>Schedule Requirements:</i>
14	<p><i>Definition of Solution:</i> Next generation technologies are available commercially, based on Topographical Mapping System (TMS), using the "time flight" laser processing versus the much more complicated and unreliable triangulation technique. This updated TMS will improve the reliability, performance and flexibility of the existing system deployed on SST 241-U-107. An ASTD proposal will be submitted for deployment in this particular case.</p>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$150K per tank in operations time and accessibility
18 *	<p><i>Potential Cost Savings Narrative:</i> Measurements (scans) are performed in real time (seconds) not hours. Mapping efforts will not hold up operations. By combining the viewing system and the dimensional mapping in one device, it will save available risers for others operations. The system is a useful and effective support for retrieval (mass balance, leak monitoring) and for post-retrieval (residual waste volume). Due to limited accessibility in Hanford SSTs, the new system would be safely deployable in a four-inch riser, making available several more access points per tank and minimizing costly equipment removal needed to support TMS operation. A combined viewing system frees yet an additional riser for the retrieval system.</p>
***	<i>Technical Basis:</i>
19	<i>Cultural/Stakeholder Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i> (will be fixed later)

23 *	<i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried.
28 *	<i>Earliest Date Required:</i>
29 *	<i>Latest Date Required:</i> Late FY 02 to support S-112, FY 03 to support S-102
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Current topographical mapping system (TMS) technology was designed specifically for use in Hanford tanks, but has been superseded in recent years due to developments and advances in mapping and imaging technologies. Technology is accurate, but time consuming and outdated from a software and data acquisition perspective. Design could be improved upon for use in flammable gas tanks at Hanford. <i>Technology Insertion Point(s):</i>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> B. E. (Brian) Brendel, 509-373-1442, F/509-373-6101, Brian_E_Brendel@rl.gov
35	<i>DOE End User POCs:</i>
36***	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-371-3607, F/509-371-3504, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

***ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Toxic Gas Control During Waste Retrieval
2 *	<i>Need Code:</i> RL-WT116
3 *	<i>Need Summary:</i> There is the potential for toxic gases to be a problem during retrieval of waste from single-shell tanks. The current baseline does not require treatment of toxic gases during all retrievals. The toxic gases are primarily ammonia with small amounts of volatile organics. The sluicing in C-106 was delayed due to unexpected toxic gas releases in the tank. There is a need for an improved understanding of how toxic gases are released, how fast, and how they can be controlled.
4 *	<i>Origination Date:</i> November 2001
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval <i>PBS No.:</i> ORP-TW04
9 *	<i>National Priority:</i> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is: <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms.
12	<i>Need/Problem Description:</i> Single-shell tanks contain gases that have the potential of being hazardous or at least a nuisance. These gases include ammonia and certain volatile organic species. Headspace sampling of single-shell tanks has demonstrated that hazardous gases are present. The ammonia may not be a problem, as any retrieval method will add water. Ammonia is soluble in water and so may not present a problem for the current baseline retrieval method, sluicing. However, some alternative retrieval methods are being considered that do not involve addition of large quantities of water, and therefore may not prevent ammonia release as well. In addition, sluicing may disturb zones where volatile

	<p>organic gases are currently residing.</p> <p>How toxic gases are released, how fast, and how they can be controlled are not well understood. These need to be better understood to develop compliance strategies with applicable regulatory requirements for Environmental, Safety, and Health for future SST retrieval. The needed information will help design cost effective and compliant retrieval systems..</p> <p>*** Program Baseline Summary (PBS) No.: TW04</p> <p>*** Work Breakdown Structure (WBS) No.: 5.02.01.01.01</p> <p>*** TIP No.: The need for this is prior to sluicing single-shell tanks. This is 2007.</p>
13	<i>Functional Performance Requirements:</i>
***	<i>Schedule Requirements:</i> The information from this study should be available prior to final design of the sluicing systems for retrieval of single-shell tanks.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> This is mostly a cost/schedule avoidance issue. (See #18 below.)
18 *	<p><i>Potential Cost Savings Narrative:</i> Cost savings are not easily estimated. The biggest cost benefit would be in not losing time and schedule should a toxic gas release occur unexpectedly. Understanding of this problem may allow for engineering or operational actions that will preclude a problematic release. Increased worker safety has the potential of being the biggest impact of this activity.</p>
***	<i>Technical Basis:</i> The recent sluicing campaign in tank C-106 had substantial delays because of potential problems with toxic gases. While a work around was found, some weeks were lost. In the future, the schedule may be tighter and such delays may be very costly. Understanding the need for toxic gas control may allow design or operation changes prior to start up to prevent these delays.
19	<i>Cultural/Stakeholder Basis:</i> Long-term disposal of the high-level wastes stored in Hanford's underground tanks is a national priority. The DOE has a legal agreement (the Tri-Party Agreement) with the Environmental Protection Agency and the State of Washington Department of Ecology to dispose of the waste according to a stated schedule. Native American tribal interests and a number of public interest groups monitor adherence to this agreement. Program delays due to inability to retrieve and deliver waste feeds containing solids may violate the Tri-Party Agreement.
20	<i>Environment, Safety, and Health Basis:</i> Worker safety and health hazards could be more effectively controlled by a better understanding of the potential for toxic gas releases.
21	<i>Regulatory Drivers:</i>
22 *	<i>Milestones:</i>
23 *	<i>Material Streams:</i> Hanford high-level defense waste. TW03 - Sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Single Shell Tank systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high morality sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2007
29 *	<i>Latest Date Required:</i> FY 2020
Baseline Technology Information	
30	<i>Baseline Technology (ies)/Process:</i> Technology Insertion Point: The need for this is prior to sluicing single-shell tanks. This is 2007.
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> D.A. (Dan) Reynolds, CHG, 509-373-3115, F/509-373-4641 Daniel_A_Reynolds@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36**	<i>Other Contacts:</i> A. F. (Anne-Marie) Choho, CHG, 509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov K.A. (Ken) Gasper, CHG, 509-371-3607, F/509-371-3504, Kenneth_A_Ken_Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

DISPOSAL

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Standard Method for Determining Waste Form Release Rate
2 *	<i>Need Code:</i> RL-WT015
3 *	<p><i>Need Summary:</i> The release of radionuclides from a waste form and package to the environment results from the interactions between the waste form and water in the disposal system. For the disposal of immobilized low-activity tank waste (ILAW), the waste form and package are expected to be in an extremely dry environment. In such an environment, the release rate is a sensitive function of physical (temperature, water content) and chemical environment (pH and amount and type of mineral and non-mineral species).</p> <p>Waste forms are typically developed to minimize the rate of release as measured by a variety of test methods. Current ILAW product specifications require Product Consistency Test (PCT) testing and ANS 16.1 testing of the waste forms, which involve testing the waste form in an environment where water is abundant and where chemical effects are minimized. These test methods will not be representative of the expected disposal system environment at the Hanford Site. A release rate test method yielding results that can be related to the waste form release rate under expected service conditions is needed as a basis for Phase II ILAW product specifications.</p> <p>Tests are also used to determine release data for use in the analysis for the assurance that long-term public health and safety will be protected using the proposed disposal method. Such tests must examine a wider set of environmental conditions that product acceptance tests and will form the basis of the Performance Assessment for the disposal action. As shown in the Hanford Immobilized Low-Activity Tank Waste Performance Assessment (DOE/RL-97-69), the contaminant release rate from the waste form is one of the few major factors in the assurance of public health and safety. As part of the performance activity, the Pressurized Unsaturated Flow (PUF) test was developed (Proceedings of the American Ceramic Society and of Materials Research Society) by the Pacific Northwest National Laboratory to obtain contaminant release rates from waste form under dry conditions.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Opportunity
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Disposal PBS No: RL-TW09
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<i>Operations Office Program Description:</i> The River Protection Project's Project Organization upgrades the SST and DST System for continued safe storage and receipt of radioactive waste as well as the design, construct and operate the immobilized waste storage and disposal facilities.

	<p>The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters.</p>
12	<p><i>Need/Problem Description:</i> Develop a standard waste form release rate test method that is relevant to expected performance in the disposal environment and that can be used as an ILAW product specification. The test should be accepted by a standards test organization such as the American Society of Testing and Materials (ASTM).</p> <p>The test method must provide usable results within a 90-day time period such that the compliance of the waste form to the product specifications can be confirmed and payment to the private contractor authorized. The test method will be implemented in a production environment. The test method must be suitable over a range of temperatures ($T = 14$ to 90°C), moisture conditions ($\phi = 0.1$ to 1.0), and pH (6.0 to 12.0) conditions for use in performance assessment activities.</p> <p>This need is described in Section 9.3.1 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Without data for long-term tests under expected conditions, the performance assessment will use conservative parameters which would require DOE to set tighter requirements on immobilization product vendors or on disposal facility design. Inadequate specification of release rates could lead to future environmental impacts.</p> <p>Program Baseline Summary (PBS) No.: TW09 Work Breakdown Structure (WBS) No.: 5.04.01.03 TIP No.: 2005 ILAW PA Data Package</p>
13	<p><i>Functional Performance Requirements:</i> Develop and standardize a waste form release rate method applicable to dry environments. The effort should compare results from this method to others. Conduct sufficient tests (under a variety of geochemical and hydraulic conditions and using a variety of waste forms) to provide data to form a basis for Phase II waste form release rate specification. Coordinate efforts with Hanford Immobilized Low-Activity Tank Waste Performance Assessment to ensure that environmental conditions are typical of the Hanford Site.</p> <p>Outsourcing Potential: Uses of glass as a waste form are in unsaturated media. Having a more suitable, standardized test would be of significant value in the DOE complex as well as in private industry.</p>
**	<p><i>Schedule Requirements:</i> A standard method for determining waste form release rate and supporting data is needed to prepare the ILAW product specifications for Phase II of the RPP/ U.S. Department of Energy, Office of River Protection (ORP) outsourcing beginning in approximately 2006.</p>
14	<p><i>Definition of Solution:</i> Work with a standards organization (ASTM being the most likely), standardize the PUF test so that it can be used in contracts.</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)</p>
16	<p><i>Potential Benefits:</i> The use of the PUF test for performance specifications would allow a more appropriate test for the acceptance for immobilized waste in a disposal facility. Other standardized tests cannot distinguish among qualified and unqualified waste form compositions.</p>
17 *	<p><i>Potential Cost Savings:</i> Benefit is cost avoidance of accepting a waste form that would not have the required long-term performance. Current estimates of ILAW immobilization are about 10 billion</p>

	dollars.
18 *	<i>Potential Cost Savings Narrative:</i> A better understanding of long-term release might allow DOE to relax requirements for the short-term testing now required under the outsourcing contract. A more relevant test method could lead to product specifications that are easier to achieve and perhaps to simpler disposal system designs.
**	<i>Technical Basis:</i> Numerous test methods including those prescribed by the Materials Characterization Center (MCC), the Product Consistency Test (PCT), and the American Nuclear Society (ANS) standard 16.1 have been used to determine waste form release rates. Current methods for measuring release rates from a waste form do not mimic the conditions that the waste form will experience in the disposal environment. A standardized test is needed. Moreover, these tests have been shown to be inadequate for discriminating between suitable and unsuitable waste form compositions.
19	<i>Cultural/Stakeholder Basis:</i> Stakeholders are interested in the parameters, which drive environmental impact, rather than the parameters that are specified in a contract and only have a weak relationship to real-life performance. On-site disposal of ILAW results in the largest inventory of radioactive material to be left at the Hanford Site; thus, the waste form for this disposal is of prime concern to stakeholders.
20	<i>Environment, Safety, and Health Basis:</i> As documented in the ILAW performance assessment (approved by EM-1), the long-term contaminant release rate is the driving factor in determining human health and environmental impact from the disposal of the low-activity fraction of the Hanford Site tank waste.
21	<i>Regulatory Drivers:</i> DOE Order 435.1 requires that waste acceptance criteria address chemical and structural stability of waste packages. The same order requires an assessment of long-term public health and safety. Contaminant release rates are an important input to this assessment. Long-term waste form testing is a requirement of the Hanford Site Waste Disposal Authorization Statement issued by EM-1. This effort will also support Washington State permitting requirements under WAC 173-303.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA
23 *	<i>Material Streams:</i> Immobilized low-activity waste (Hanford Site)
24	<i>TSD System:</i> ILAW Disposal Facility
25	<i>Major Contaminants:</i> Not applicable
26	<i>Contaminated Media:</i> Not applicable
27	<i>Volume/Size of Contaminated Media:</i> 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. All double shell tanks are 75 feet in diameter, and about 40 feet deep, and are similarly buried
28 *	<i>Earliest Date Required:</i> FY 2001
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Standardized tests are in fully immersed or saturated media (PCT, MCC) or in vapor (at high temperatures). Performance of tests at proper temperature, m numbers T9460160Fx. <i>Technology Insertion Point(s):</i> 2005 ILAW PA Data Package
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>

33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG, (509) 372-9204, Fax: (509) 372-9447, frederick_m_mann@rl.gov
35	<i>DOE End User POCs:</i> P.E. (Philip) LaMont, DOE-RL/ORP, (509) 376-6117, Fax: (509) 373-0628, philip_e_lamont@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36***	<i>Other Contacts:</i> G.L. (Greg) Parsons, CHG, (509) 371-3783, Fax: (509) 371-3510, greg_l_parsons@rl.gov 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_Chocho@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Glass Monolith Surface Area
2 *	<i>Need Code:</i> RL-WT016
3 *	<i>Need Summary:</i> A method is needed to estimate the surface area of vitrified low-activity waste (LAW). The contaminant release rate from glasses is proportional to the surface area reachable by moving moisture. As glass cools it experiences internal stresses and strains, which may cause the glass to crack and hence increase the surface area on the glass. External stresses (for example, those caused by earthquakes) could also increase surface area. In addition, cracks may expose imperfections in waste form (internal gas pockets, nucleation sites, and devitrification regions), which may cause increased contaminant release rates. Relatively little is known about the long-term behavior of such cracks. Yet the total contaminant release must be known (or at least estimated) for thousands of years.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Disposal <i>PBS No:</i> RL-TW09
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The River Protection Project's Project Organization upgrades the SST and DST System for continued safe storage and receipt of radioactive waste as well as the design, construct and operate the immobilized waste storage and disposal facilities. Activities include transferring waste to waste treatment facilities, maintaining and evaluating operating and surveillance systems necessary for compliance with regulatory and AA/AB requirements, identifying if systems are reliable for this mission, transferring waste within the SSTs and DSTs to manage the limited available space; characterizing waste to understand its properties, and developing flow sheets for waste treatment. The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters.
12	<i>Need/Problem Description:</i> The total contaminant release rate from a glass waste form depends not only the intrinsic release rate but also the effective surface area over which that intrinsic release rate is applicable. Technologies are needed to measure the effective surface area (i.e. the total wetted area, including internal cracks, of the glass monolith) as well as the ability to predict

	<p>total wetted area, including internal cracks, of the glass monolith) as well as the ability to project this quantity as a function of time.</p> <p>This need is described in Section 9.3.2 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Without data, the performance assessment will use conservative parameters, which would require DOE to set tighter requirements on immobilization product vendors or on disposal facility design, thus increasing costs. Better definition of contaminant release will lead to a performance assessment, which can more easily be defended.</p> <p>Program Baseline Summary (PBS) No.: TW09 Work Breakdown Structure (WBS) No.: 5.04.01.03 TIP No.: 2005 ILAW PA Data Package</p>
13	<p><i>Functional Performance Requirements:</i> For typical LLW glass monoliths using a variety of sizes and cooling methods:</p> <ul style="list-style-type: none"> • Determine surface area and crack patterns. • Determine area reachable by moisture. • Accelerate aging and repeat measurements. <p>Determine unsaturated hydraulic properties of fractured and aged specimens.</p> <p>Outsourcing Potential: Methods could support the vitrification technology industry by providing a means to determine total contaminant release rate.</p>
	<p><i>Schedule Requirements:</i> A standard method for determining waste form release rate and supporting data is needed to prepare the ILAW product specifications for Phase II of the RPP/ORP outsourcing beginning in approximately 2006.</p>
14	<p><i>Definition of Solution:</i> meet functional requirements</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)</p>
16	<p><i>Potential Benefits:</i> Reduce requirements established by performance assessment (which are enforceable through the EM-1 issued Hanford Site Waste Disposal Authorization Statement) on the quality of the ILAW produced by the Waste Treatment Contractor.</p>
17 *	<p><i>Potential Cost Savings:</i> Possible cost savings could be in the hundreds of millions of dollars, especially if higher waste loadings are allowed.</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> A better understanding of long-term release might allow DOE to relax requirements for the short-term testing now required under the outsourcing contract. Possible cost savings could be in the hundreds of millions of dollars.</p>
	<p><i>Technical Basis:</i> Contaminant release from the waste form is proportional to the surface area reachable by moving moisture. This release rate determines the impact from waste disposal using very slow-release waste forms.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Stakeholders are interested in the parameters, which drive environmental impact, rather than the parameters that are specified in a contract and only have a weak relationship to real-life performance. On-site disposal of ILAW results in the largest inventory of radioactive material to be left at the Hanford Site; thus, the waste form for this disposal is of prime concern to stakeholders.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> As documented in the ILAW performance assessment (approved by EM-1), the long-term contaminant release rate is the driving factor in determining</p>

	human health and environmental impact from the disposal of the low-activity fraction of the Hanford Site tank waste.
21	<i>Regulatory Drivers:</i> DOE Order 435.1 requires that waste acceptance criteria address chemical and structural stability of waste packages. The same order requires an assessment of long-term public health and safety. Contaminant release rates are an important input to this assessment. Long-term waste form testing is a requirement of the Hanford Site Waste Disposal Authorization Statement issued by EM-1. This effort will also support Washington State permitting requirements under WAC 173-303.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA
23 *	<i>Material Streams:</i> Immobilized Low-Activity Waste (Hanford Site)
24 *	<i>TSD System:</i> ILAW disposal facility
25	<i>Major Contaminants:</i> Not applicable
26	<i>Contaminated Media:</i> Not applicable
27	<i>Volume/Size of Contaminated Media:</i> Not applicable
28 *	<i>Earliest Date Required:</i> FY 2001
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Conservative extrapolations from 1980's waste forms. Technology Insertion Point(s): 2005 ILAW PA Data Package
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG, (509) 372-9204, Fax: (509) 372-9447, frederick_m_mann@rl.gov
35	<i>DOE End User POCs:</i> P.E. (Philip) LaMont, DOE-RL/ORP, (509) 376-6117, Fax: (509) 373-0628, philip_e_lamont@rl.gov ; E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov
36***	<i>Other Contacts:</i> Greg Parsons, CH2M Hill Hanford Group, (509) 371-3783, Fax: (509) 371-3510, greg_l_parsons@rl.gov 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_Chocho@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Compositional Dependence of the Long Term Performance of Glass as a Low-Activity Waste Form
2 *	<i>Need Code:</i> RL-WT066
3 *	<p><i>Need Summary:</i> The present plan for the 54 million gallons of Hanford tank waste is to retrieve the waste from the underground tanks, separate the waste into a high-level fraction (containing most of the radionuclides and hazardous materials) and into a low-activity fraction (containing most of the waste). Both fractions will be immobilized, with the immobilized high-level fraction stored until shipped to a federal geologic repository and the immobilized low-activity fraction disposed of on the Hanford Site.</p> <p>Because of the relatively large amount of contaminants in the Immobilized Low Activity Waste (ILAW) form, the rate of release must be slow and the rate limited for hundreds of thousands of years. Estimating such a long-term release rate from short-term experiments (even those lasting many years) requires a strong database, an understanding of the degradation process, and numerical simulation tools that combine the database and a mathematical model of the glass corrosion process.</p> <p>DOE will enter into a contract for the treatment of the tank waste. However, a particular glass composition is not expected to in the near future. As a result, the Immobilized Waste Program is performing a series of tests on representative LAW glasses to better understand how likely glasses will perform over these long periods of time. The vision for this work is given in A Strategy to Conduct an Analysis of the Long-Term Performance of Low-Activity Waste Glass in a Shallow Subsurface Disposal System at Hanford (PNNL-18834 or Appendix G of DOE/RL-97-69). However, there are some areas presently not being funded by EM-30. Rather the support is from EM-50, because of its greater applicability to other potential disposal actions. In particular, the database must be expanded so the affect of different glass compositions on long-term performance can be determined. An important subset of this need is to understand how glass composition impacts the rate of sodium ion-exchange in LAW glasses, which has been found to significantly affect the calculated pH in the disposal system and thus the long-term radionuclide release rate.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Disposal <i>PBS No:</i> RL-TW09
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	

11	<i>Operations Office Program Description:</i> The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters.
12	<p><i>Need/Problem Description:</i> Perform tests (PCT, PUF, SPFT, and VHT) that enable prediction of the long-term performance of low-activity waste glasses similar to those proposed glasses by the Waste Treatment Plan Contractor. The results must be suitable for use in numerical modeling performed for the Immobilized Waste Program.</p> <p><i>Consequences of Not Filling Need:</i> Without these data, the ILAW disposal system approval process (involving DOE, Washington State, and the Nuclear Regulatory Commission) will require the use of quite conservative parameters, resulting in significant costs.</p> <p>Program Baseline Summary (PBS) No.: TW09 Work Breakdown Structure (WBS) No.: 5.04.01.03 Dispose ILAW *** TIP No.: 2005 ILAW PA Data Package *** This need is described in Section 9.3.3 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p>
13	<p><i>Functional Performance Requirements:</i></p> <ul style="list-style-type: none"> • Create a series of glass compositions around the expected glass composition and measure the release rates of important constituents from those glasses. These measurements shall include PCT (product consistency test), PUF (pressurized unsaturated flow) tests, SPFT (single-pass flow-through) tests, and VHT (vapor hydration test). • Determine the sodium ion-exchange kinetic rate constants as a function of pH, temperature, sodium, and moisture for a series of glasses. <p><i>Outsourcing Potential:</i> The use of glass as a low-level waste form is under consideration for many applications where low release rates are a requirement. The ILAW program together with on-going EM-50 programs is providing the best data for non-Hanford applications of low-level glass waste forms.</p>
***	<p><i>Schedule Requirements:</i> For use in the 2005 Hanford Immobilized Low-Activity Tank Waste Performance Assessment, the results of the tests are needed by April 2003.</p> <p>For use in shaping the requirements of the Phase 2 contract to treat tank waste, the results of the tests are needed by September 2008.</p>
14	<i>Definition of Solution:</i> See functional requirements
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> Forms the technical basis that a major part of the goal of the ORP program (disposal of immobilized tank waste) can actually be accomplished.
17 *	<i>Potential Cost Savings:</i> The possible elimination of the technetium separation processes and increases in waste loadings, either of which would save at least a billion dollars, are already identified. Reduced costs for the construction and operation of the disposal facilities would probably be an order of magnitude less, but still mounting to hundreds of millions of dollars.
18 *	<i>Potential Cost Savings Narrative:</i> The contract for the treatment of Hanford tank waste is the largest contract DOE will be involved with. The value of initial contract is about 10 billion dollars, with the succeeding contracts totaling many times more. By balancing the requirements of environmental protection and cost, DOE should be able to save at least 5% of the contract costs.

	mounting to billions of dollars. The possible elimination of the technetium separation processes and increases in waste loadings, either of which would save at least a billion dollars, are already identified. Reduced costs for the construction and operation of the disposal facilities would probably be an order of magnitude less, but still mounting to hundreds of millions of dollars.
**	<i>Technical Basis:</i> Because of the different compositions in tank waste, different ILAW glass formulations will be used. The Hanford Immobilized Low-Activity Tank Waste Performance Assessment: 2001 Version (DOE/ORP-2000-24) has demonstrated that one of the few key parameters is the release rate of contaminants from the ILAW glass. Since the release rate is known to depend strongly on waste form composition, an understanding of this dependence is necessary for successful implementation of the scope of the Office of River Protection.
19	<i>Cultural/Stakeholder Basis:</i> Stakeholders are interested in the parameters, which drive environmental impact, rather than the parameters that are specified in a contract and only have a weak relationship to real-life performance. On-site disposal of ILAW results in the largest inventory of radioactive material to be left at the Hanford Site; thus, the waste form for this disposal is of prime concern to stakeholders.
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i> As documented in the ILAW performance assessment (approved by EM-1), the long-term contaminant release rate is the driving factor in determining human health and environmental impact from the disposal of the low-activity fraction of the Hanford Site tank waste.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA (2004)
23 *	<i>Material Streams:</i> Immobilized low-activity waste (Hanford Site)
24	<i>TSD System:</i> ILAW Disposal Facility
25	<i>Major Contaminants:</i> Not applicable
26	<i>Contaminated Media:</i> Not applicable
27	<i>Volume/Size of Contaminated Media:</i> A majority of the 54 million gallons of Hanford tank waste will be converted to Immobilized Low Activity Waste.
28 *	<i>Earliest Date Required:</i> October 2001
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Conservatism will be used to bound expected behaviors. Because of the extrapolation from short-term tests on a very few glass compositions and environments and the impacts of a poor extrapolation, a significant amount of conservatism will occur. <i>Technology Insertion Point(s):</i> 2005 ILAW PA Data Package
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i> Post 2020
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG, (509) 372-9204, Fax: (509) 372-9447, frederick_m_mann@rl.gov
35	<i>DOE End User POCs:</i>

	<p>P.E. (Philip) LaMont, DOE-RL/ORP, (509) 376-6117, Fax: (509) 373-0628, philip_e_lamont@rl.gov</p> <p>E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov</p>
36 **	<p><i>Other Contacts:</i></p> <p>G.L. (Greg) Parsons, CHG, (509) 371-3783, Fax: (509) 371-3510, greg_l_parsons@rl.gov</p> <p>K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov</p> <p>A.F. (Anne-Marie) Choho, NHC, 509-509-372-8280, F/509-373-6382, Anne-Marie_F_Chocho@rl.gov</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

CLOSURE

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Technetium-99 Analysis In Hanford Tank Waste
2 *	<i>Need Code:</i> RL-WT001
3 *	<i>Need Summary:</i> An accurate, robust production laboratory method for the measurement of technetium-99 (⁹⁹ Tc) concentration in Hanford Site waste tank matrices is needed. New TPA (Tri-Party Agreement) strategy has Hanford tanks being sequenced for retrieval based on environmental risk. For tank S-112, ⁹⁹ Tc is the main driver for risk. Assumptions for Tc ⁹⁹ solubility significantly impact the risk results for allowable leak loss during retrieval, as well as allowable residuals after retrieval. Methods for evaluating and verifying the solubility and mobility of contaminants of concern, such as Tc ⁹⁹ , during retrieval and post retrieval operations is critical for developing risk based Leak detection, monitoring and mitigation strategies for SST retrieval. Methods must provide a high level of confidence to resolve risk uncertainties associated with tank farm retrieval performance evaluations
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Opportunity -- The site desires an alternative to the current or planned baseline technology/process (e.g., a baseline exists but can be improved).
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval and Closure <i>PBS No:</i> ORP-TW04 and ORP-TW11
9 *	<i>National Priority:</i> <u>X</u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. ___ 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms. <p>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 follow ing retrieval. the tanks themselves. the tank</p>

	<p>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.</p>
12	<p><i>Need/Problem Description:</i> An accurate production laboratory and/or field methods for establishing the ^{99}Tc concentration in LLW is needed. ^{99}Tc concentration is a critical component of feed to the waste vitrification vendors as well as a key risk driver that establishes values for allowable leak thresholds and residual waste limits for SST retrieval projects. The absolute accuracy of these analytical results produced at the Hanford Site has been questioned and found to be in disagreement with results produced at another U.S. Department of Energy (DOE) site. This original issue appears to be resolved based on work in FY 1998 for the high-organic-containing waste in which these differences were observed. Variability of REDOX potential and interferences present in Hanford Site tank waste can produce inconsistent performance of radiochemical sample preparation methods in use. Technetium in the +7 oxidation state is known to be mobile in the soil column and therefore, the concentration in tank waste must be known well to estimate long-term effects of waste tank leakage during storage or retrieval operations. The use of ICP/MS in place of radiochemical methods may also help resolve some of these chemical issues; however, insufficient comparison data are available to fully support the ICP/MS results. Because the ICP/MS does not require chemical separations before analysis, it is less subject to the interferences described above. However, there may be other errors associated with sample dissolution or polyatomic interferences that have not been clearly defined for this relatively new technology. Finally, when the technology is generating data that is being used to determine an impact on public/worker safety and health and is being critically reviewed by stakeholders, inter-laboratory comparisons of the measurement system are needed to raise the level of confidence in the data and credibility of the technology independent of the site at which it being used.</p> <p>Failure to develop accurate and reliable measurement methods that are recognized by the regulators, stakeholders, and process operations as confident measurement systems will affect final waste processing requirements and site clean-up criteria. Needs associated to these requirements and criteria are addressed under RL-WT069, <i>Value of Information Decision Analysis for Tank Farm Closure</i>. Accurate ^{99}Tc measurements are needed to produce effective risk assessments and ensure that vitrification processes and products will meet acceptance criteria. Failure to meet those criteria could result in additional program costs or regulatory requirements.</p> <p>*** Program Baseline Summary (PBS) No.: TW04, TW11 *** Work Breakdown Structure (WBS) No.: 5.02.01.02.07.12 and 5.05.01.01 *** TIP No.: M-45 Series Milestones for Tank Waste Closure Plans</p>
13	<p><i>Functional Performance Requirements:</i> Because the method will be frequently requested in the waste disposal program, it must be appropriate for production laboratory use to routinely measure ^{99}Tc not only in tank waste matrices, but also in processed or treated waste. Performance requirements will vary for the different applications of the data and matrices.</p> <p>For example, the estimated quantitation limit (EQL) for ^{99}Tc in the low-level waste (LLW) as stated in the Interface Control Document (ICD-19) is $5 \times 10^{-4} \mu\text{Ci/mL}$. The LLW data quality objective (DQO), WIT-98-010, Table 7-2, provides a basis of the accuracy requirements which range from 10% to no accuracy requirement depending on how close it is to the average tank concentration. The minimum reportable quantity for this DQO for performance assessment is</p>

	<p>2.0xE-2 $\mu\text{Ci/mL}$. The relative percent difference between duplicates to support this DQO is less than 20%. Many of these DQOs are still in the draft stages and can be expected to change, but these criteria are not expected to be lessened. The method should be rapid (preferably less than 4 hours per batch for preparation and 1 hour per batch for analysis) and permit reasonably large batch sizes (4 to 10 samples + quality control samples). The use of hazardous chemicals and generation of waste should be minimized.</p> <p>A validated and acceptable method will be needed to support LLW and high-level waste (HLW) feed characterization and acceptance by the Privatization vendor. The schedule for this activity is changing with the awarding of the contract to the Bechtel Northwest Group. However, if data from present characterization are to be utilized to support the certification of the waste transferred, the need is immediate. Work was completed in fiscal year (FY) 1998 that resolved the problems associated with analyzing ^{99}Tc in waste with high organic complexant content in which ^{99}Tc data were bias low because of incomplete oxidation of ^{99}Tc. However, there have been instances in FY 1998 where the radiochemical results are higher than the inductively coupled plasma/mass spectrometer (ICP/MS). This indicates the existing method may not be reliable in all matrices and the limits of reliability are not established. During FY 1999, investigation showed carry through of beta emitting ^{241}Pu, originating from chemical enhancement of plutonium in tank sludges through precipitation. While corrections were made in liquid scintillation counting, carry through of plutonium in the chemical separation is not resolved. There are also indications in the analysis of waste from AX-104 that the regulatory acid digestion methods may not be quantitative for these types of sludges. There have also been indications that analyses for ^{99}Tc are higher than predicted by modeling at both SRL and Hanford. Waste characterization is ongoing with future emphasis on privatization and waste disposal.</p> <p>New TPA (Tri-Party Agreement) strategy has Hanford tanks being sequenced for retrieval based on environmental risk. For tank S-112, ^{99}Tc is the main driver for risk. Assumptions for Tc^{99} solubility significantly impact the risk results for allowable leak loss during retrieval, as well as allowable residuals after retrieval. Methods for evaluating and verifying the solubility and mobility of contaminants of concern, such as Tc^{99}, during retrieval and post retrieval operations is critical for developing risk based Leak detection, monitoring and mitigation strategies for SST retrieval. Methods must provide a high level of confidence to resolve risk uncertainties associated with tank farm retrieval performance evaluations.</p> <p>Presently ^{99}Tc can be determined by radiochemical and ICP/MS techniques. When both techniques provide equivalent results they can be confidently reported. Presently, the amount of these comparison data is limited and occasional discrepancies are being seen. If the ^{99}Tc results are near decision limits for a project, higher confidence will be needed for the procedure. In this case, the use of inter-laboratory comparisons can be used to support the results. A ^{99}Tc workshop was held in September 1998 with the users of these data and the need for better ^{99}Tc data and methods of analyses was supported.</p> <p>This study applies primarily to the DOE complex but could also be of value to privatization contractors doing work for DOE.</p>
**	<i>Schedule Requirements:</i> Support M-45 Series Milestones for Tank Waste Closure Plans
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>

17 *	<i>Potential Cost Savings:</i> \$15,000,000 to \$20,000,000
18 *	<i>Potential Cost Savings Narrative:</i> Potential cost savings are represented by a measurement method that assures the vendor and DOE that a true concentration of the ^{99}Tc has been measured, manifests of the waste and site are accurate, and the vendor or regulator should not have concern about the DOE-supplied concentration data. Current assumptions are that all technetium in tank waste is in the +7 valence state and is very mobile. This has an impact on long-term health risks and implications on retrieval system designs and leak mitigation requirements. An understanding of not only ^{99}Tc content, but distribution of its various valence states and their mobility and chemical stability can greatly influence risk assessment data. Better understanding of the actual form of technetium in tank wastes could result in more flexibility in using fluid-based retrieval system designs and leak mitigation provisions.
**	<p><i>Technical Basis:</i> Private vendors will receive LLW after it is characterized and concentrations of analytes documented. If sensitive analyte concentrations such as ^{99}Tc are inaccurately represented, the DOE will be responsible for the environmental and process rework caused. Without this interlaboratory testing and acceptance, the liability is likely to remain unresolved.</p> <p>There has been an increased interest in defining the inventory and distribution of ^{99}Tc in the tanks. This interest also includes a better understanding of the speciation of technetium in the waste. Reliable ^{99}Tc methods will be required to provide the data to understand technetium behavior in Hanford Site tanks.</p>
19	<i>Cultural/Stakeholder Basis:</i> Measurement data will have better credibility with the oversight panels when the measurement methodology has been peer-reviewed and accepted. Issues concerning emissions from the pretreatment and vitrification processes should be answerable with documented data.
20	<i>Environment, Safety, and Health Basis:</i> Pertechnetates can be volatilized during processing of waste for vitrification. High concentrations not removed during pretreatment may be disbursed through the gaseous emissions during the vitrification process. Feed to the private vitrification vendor must be properly classified and manifested. Leakage during storage or retrieval operations may deposit waste containing ^{99}Tc into the soils surrounding the tanks. The mobility and long half-life of the isotope makes the concentration value significant for environmental consequences.
21	<i>Regulatory Drivers:</i> The ^{99}Tc concentration in feed streams classified as LLW are critical since the resulting vitrified product may contain inventory beyond the permitted quantities for onsite disposal.
22 *	<i>Milestones:</i> T04-01-W21, M-45-55-T01, M-45-55-T02
23 *	<i>Material Streams:</i> Sludge, Saltcake, Liquid (RL-HLW-20)
24	<i>TSD System:</i> N/A
25	<i>Major Contaminants:</i> Soluble, mobile +7 valence state of Technetium as well as insoluble +3 and +4 valence states; including impacts of complexants on increasing Technetium mobility.
26	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> 9/30/01
29 *	<i>Latest Date Required:</i> 2010 (Finalized Tank Waste Closure Plan)
Baseline Technology Information	

30	<p><i>Baseline Technology/Process:</i> The current baseline technology is radiochemical measurement of ⁹⁹Tc. The alternative technology is ICP/MS. ICP/MS offers significant advantages in time required for analysis and reduced waste generation in the laboratory. However, the radiochemical technology could still be valuable for speciation studies.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i></p> <p>D.W. (Dennis) Crass, NHC, 509-372-2034, F/509-373-4311, Dennis W Crass@rl.gov</p>
35	<p><i>DOE End User POCs:</i></p> <p>E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov</p>
36 **	<p><i>Other Contacts:</i></p> <p>B.E. (Brian) Brendel, CE&ES, 509-373-1442, F/509-373-6101, Brian E Brendel@rl.gov J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry W Cammann@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Long-Life Waste Isolation Surface Barrier
2 *	<i>Need Code:</i> RL-WT017
3 *	<p><i>Need Summary:</i> Surface barriers are being used over many Hanford Site waste sites contaminated with low-level radionuclides and/or chemical contaminants. Many more waste sites are expected to use such barriers in the future. Such barriers are used to reduce moisture infiltration and plant and animal intrusion. Short-term testing of barriers has occurred under project-sponsored activities, but long-term studies remain a funding orphan. Since the design life of the barrier is 500 to 1,000 years, data will be needed on degradation to better understand the validity of the design life estimate. Concern exists regarding the integrity of barrier designs and the definition of adequate testing to verify barrier performance. This technology need relates to the generation and subsequent regulatory acceptance of adequate design, selection, validation, and monitoring results. Acceptance of these results will allow an environmentally sound, cost-effective, graded design approach for barrier implementation at the Hanford Site.</p> <p>The same Needs statement has been submitted to both the Subsurface Contaminants and Tank Focus Areas</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Closure PBS No.: RL-TW11
9 *	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> Fifty years of defense plutonium production resulted in the creation of

a large number of waste sites in the Hanford Site's 100, 200, and 300 Areas. The 100 Areas are located along the Columbia River and include nine nuclear reactors previously used for plutonium production. The 300 Area is also located along the Columbia River and contains the fuel fabrication facilities. The 200 Area is located on the central plateau and contains the spent fuel extraction and processing facilities and the radioactive waste storage tanks. The Hanford Site's burial grounds contain a variety of solid waste debris, including construction waste, discarded equipment, and protective clothing. Much of this waste is contaminated with low-level radioactive materials. The baseline for the 100 and 300 Area sites is excavation and disposal in onsite facilities. However, acceptable long-life surface barriers would help support decisions to cap some burial grounds in place. Capping selected 100 and 300 Area burial grounds in place could result in cost savings of over \$500M.

The 200 Area remediation includes a combination of removal and leave-in-place with in situ treatment and/or barrier placement strategies. Sites within areas that will be used for waste management and other industrial uses or sites where capping provides better, more cost-effective protection of human health and the environment are the main candidates for surface barriers. Failure to establish an acceptable long-life surface barrier could result in excavation requirements that would be cost prohibitive.

Currently 99% of the high-level waste contained in the 177 tanks in the Hanford Site tank farms is planned to be retrieved. After further remediation, the tank farms are planned to be closed (including the use of a surface barrier). The retrieved waste will be separated into two streams, each of which is planned to be vitrified. The high-level waste will be stored at the Hanford Site until it is sent to a geological repository. The ILAW will be disposed onsite. Current closure plans include a surface barrier to limit infiltration.

In FY 1997, Bechtel Hanford, Inc., and Pacific Northwest National Laboratory completed 3 years worth of field performance testing and monitoring for the Hanford Prototype Barrier as part of a treatability test. Additional but limited field performance testing and monitoring continues in FY 1998. The purpose of this treatability test was to demonstrate the effectiveness of construction techniques and barrier performance. Data from this test could also be used to demonstrate acceptability of less robust barriers for use at the Hanford Site. Data collected during these 4 years showed that the barrier worked as designed, but an acceptable methodology for extrapolating short-term data into long-term performance is still required.

The areas that are currently planned to be completed within the Environmental Restoration (ER) Project to finalize the treatability testing are as follows:

- Confirming the longevity of the asphalt layer through literature searches or by conducting accelerated aging tests and stress/strain analysis of asphaltic or asphaltic concrete mixtures to ensure that this component will not degrade during its proposed design life
- Evaluating the differential settlement of soils beneath the surface barrier and the impacts of this differential settlement on barrier integrity to establish maximum allowable settlement criteria
- Performing and documenting an independent technical peer review of the results obtained throughout the treatability test.

As barrier deployment enters the detailed design phase, considerations relating to performance of adjacent barriers (and interconnected barriers), side-slope stability, and waste site identification and warning systems will need to be addressed.

	<p>Areas that are presently not funded that require further study prior to deployment of barriers at waste sites include the following:</p> <ul style="list-style-type: none"> • Develop a model for extrapolating short-term data to address long-term performance that is acceptable to the DOE and regulators • Evaluate alternative materials and reduced thicknesses including alternatives to fluid-applied asphalt and the use of geoclay to allow a graded approach to barrier application • Analyze the edge effect of side slopes that use coarse materials such as gravel or large rocks for slope stability increase infiltration in those areas. This needs to be analyzed to determine if this is a significant issue that requires design changes <p>4. Evaluate long term monitoring techniques, including a long-term, easy-to-use, soil moisture measurement device to monitor the cap performance. These techniques would ideally be non-intrusive with minimal potential for creating a preferential pathway circumventing the barrier integrity.</p> <p>This need is described in Section 10.3.11 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Reliance on existing testing programs to assess barrier performance. Potential for capping options to be rejected, thus requiring more expensive remediation methods. The requirements-setting documents may need to use conservative values or the facility design may be more expensive than necessary. In particular, more material than necessary may be used from an area of significant cultural value or the DOE may be forced to import suitable materials from a considerable distance.</p> <p>*** Program Baseline Summary (PBS) No.: TW11 *** Work Breakdown Structure (WBS) No.: 5.05.01.01 *** TIP No.: TIP 0001 (RL-ER-01); TIP 0002 (RL-ER02); TIP 0003 (RL-ER03)</p>
13	<p><i>Functional Performance Requirements:</i> Major regulatory drivers for cover design are 10 CFR 61 (NRC), 40 CFR 264 and 265 (<i>Resource Conservation and Recovery Act of 1976 [RCRA]</i>), and 40 CFR 191 (EPA). Performance criteria for barrier designs depend on waste categories. The U.S. Department of Energy, Richland Operations Office (RL) has identified four conceptual design options for various waste compositions and radioactive activities (DOE/RL-93-33, Rev. 0). The most robust barrier design presently identified is the "Hanford Barrier" with a design life of 1,000 years, water infiltration limits to less than 0.05 cm/yr, and erosion limits of less than 4,500 kg/ha (2 tons/acre). The next most robust barrier, known as the "Modified RCRA C Barrier" is the baseline barrier for most future Hanford Site waste sites. It shares many design features with the Hanford Barrier but has a design life of 500 years.</p> <p>Outsourcing Potential: Potentially high. Surface barriers are used at many DOE and commercial sites to reduce water infiltration. Research will aid many waste management areas, particularly those in arid and semi-arid Western states.</p>
***	<p><i>Schedule Requirements:</i> Variable. The viability of barrier technology affects decisions for burial grounds in the 100 and 300 Areas and burial ground and liquid waste disposal sites in the 200 Area. The first burial ground (located in the 300 Area) is scheduled for excavation in early FY 1998. Goals established in the Hanford Ten-Year Challenge would have all burial grounds in the 100 Area and 300 Area completed by 2006. The acceptance of barriers as a remedial alternative is needed to support decisions to utilize barriers for selected burial grounds in the 100 and 300 Areas and selected burial ground and liquid waste disposal sites in the 200 Area. 200 Area remedial</p>

	alternative decision making will require barrier performance data in the FY 1998 to FY 2000 time frame. For use in the Hanford Immobilized Low-Activity Tank Waste Performance Assessments such data and testing are needed by September 2005. Closure will start occurring in 2010. Closure of tank farms is expected no earlier than 2014.
14	<i>Definition of Solution:</i> .
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$500 Million
18 *	<i>Potential Cost Savings Narrative:</i> Information from the 10-year plan indicates a potential saving of \$500M based on successful deployment of a Long-Life Waste Isolation Surface Barrier technology that enables in-place remediation of selected landfills and buried waste sites in the 100 and 300 Areas instead of the baseline of excavation and disposal in onsite facilities. Barriers are a significant part of the baseline strategy for many sites in the 200 Area. Improvements in design would establish confidence in long-term performance and would greatly affect both waste management and environmental restoration budgets.
**	<p><i>Technical Basis:</i> Installation of long-term barrier options with design lives of hundreds or more years requires very high quality testing to confidently predict design performance.</p> <p>This need is DOE complex wide for remedial action and waste management units. This need is also applicable to other U.S. government agencies, as well as private environmental restoration activities.</p>
19	<i>Cultural/Stakeholder Basis:</i> A major environmental impact identified in the Hanford Remedial Action Environmental Impact Statement is the mining of materials for surface barrier construction from the McGee Ranch of the Hanford Site. The McGee Ranch area is a wildlife corridor that many see as vital in maintaining the unique shrub-steppe biological community in this area. In addition, Hanford Site stakeholders have expressed the desire for highly predictive performance testing of barrier designs prior to selection of barriers as remediation options at waste sites.
20	<i>Environment, Safety, and Health Basis:</i> A properly installed barrier will significantly reduce risk to human health and the environment at uncontrolled surface waste sites. Also see Regulatory section below.
21	<i>Regulatory Drivers:</i> Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), RCRA, and Model Toxic Control Act (MTCA) provides requirements for environmental remediation. DOE Order 435.1 (Radioactive Waste Management) provides requirements for radioactive waste. The length of time required to move contaminants from the disposal facility to groundwater is proportional to the amount of infiltration allowed through by the surface barrier. Given DOE's definition of the time of compliance as not more than 1,000 years, the design life of the surface barrier becomes an element in a defense in depth philosophy for waste disposal system design.
22 *	<i>Milestones:</i> 2008 Closure of 200 Area Sites; 2014 Closure of first SST farm; 2024 closure of all SST farms; 2028 Closure of all tank farms
23 *	<i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20); Soil (Disposition Map Designations: ER-14: LLW Soils 200 Area)
24	<i>TSD System:</i> 200 Area liquid discharge sites; ILAW disposal facility; SST farms; DST farms
25	<i>Major Contaminants:</i> N/A
26	<i>Contaminated Media:</i> N/A

27	<i>Volume/Size of Contaminated Media:</i> N/A
28 *	<i>Earliest Date Required:</i> 2001
29 *	<i>Latest Date Required:</i> 2010
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> A cover has undergone short-term testing at the 200-BP-1 site at Hanford using environmental restoration funds. However, the funds are being greatly reduced and are scheduled to be eliminated.</p> <p>Technology Insertion Point(s): TIP 0001 (RL-ER-01); TIP 0002 (RL-ER02); TIP 0003 (RL-ER03)</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> F.M. (Fred) Mann, CH2M Hill Hanford Group, Inc., 509-372-9204, F/509-372-9447, Frederick_m_mann@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949, F/509-373-1313, robert_w_lober@rl.gov</p>
36 ***	<p><i>Other Contacts:</i> 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</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Reactive Barriers to Contaminant Migration
2 *	<i>Need Code:</i> RL-WT061
3 *	<p><i>Need Summary:</i> Although the single- and double-shell tanks store a broad range of highly radioactive isotopes, a few relatively mobile constituents dominate the risk to human health and the environment. For the vadose zone groundwater pathway based on past analysis the list typically includes technetium-99, iodine-129, selenium-79 and uranium. The relative importance of these constituents varies depending on assumptions used during the specific analysis.</p> <p>Sixty-seven of the 149 SSTs at the Hanford Site are known or suspected leakers. Retrieval of waste from these tanks will incur risk from additional leakage. In addition, waste that has been retrieved will be processed, vitrified and disposed in solid form. Based on past analyses, this waste may add radionuclides to the soil column. For example, the performance assessment activities supporting the disposal of vitrified low-activity waste identified technetium-99 and selenium-79 as the radionuclides that contributed most significantly to long-term risk. If these key radioactive elements could be trapped or immobilized in the waste matrix, disposal facility, closed tanks, and/or the soil column, the risk to human health and the environment could be significantly reduced. It is proposed that sequestering agents be deployed as a permeable flow-through (reactive) barrier to attenuate the migration of these contaminants and reduce the risk. In the case of contaminated soil, the reactive barrier will be placed using conventional emplacement technology, e.g., slant drilling, etc. For the vitrified waste and for tank closure, it is proposed that the getter could be placed inside the facility. For existing waste sites, the material may need to be injected into the soil underlying the facility.</p> <p>The same Needs Statement has been submitted to both the Subsurface Contaminants and Tank Focus Areas.</p> <p>A similar Needs Statement has been submitted by the Retrieval Projects effort as RL-WT027.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval, Closure, and Disposal PBS No.: RL-TW04, TW09, TW11
9 *	<p><i>National Priority:</i></p> <p>☐ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>☒ 2. <u>Medium</u> - 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).</p> <p>☐ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A

	<p>primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms <p>The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters.</p> <p>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.</p>
12	<p><i>Need/Problem Description:</i> Although limited efforts have been performed to identify getter materials (sequestering agents), no material has been sufficiently tested to date to be selected. During the last few years, the list of candidate materials has been reduced. Based on this work, candidate getters include bone char, hydrotalcite, iron-oxyhydroxides, sulfides, magnetite, and oxides. Research to date (performed by both Pacific Northwest National Laboratory and Sandia National Laboratories) suggests magnetite, bone char, and hydrotalcite to be most effective for attenuating technetium. Similarly, hydrotalcite and iron-oxyhydroxides are candidates for attenuating uranium and selenium. Recent efforts as part of the Immobilized Waste Program and by the Tank Focus Area champion have identified some potentially useful materials.</p> <p>This science need supports the Hanford tanks technology need RL-WT061 Reactive Barriers to Contaminant Migration.</p> <p>This need is described in Section 10.3.5 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Conservative methods and data will be used in the performance assessment, likely requiring more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities.</p> <p>*** Program Baseline Summary (PBS) No.: RL-TW04, TW09, TW11</p> <p>*** Work Breakdown Structure (WBS) No.: 5.05.01.01; 5.04.01; 5.02.01.01.02.02</p> <p>*** TIP No.: TIP 0001 (RL-ER01), TIP 0002 (RL-ER02), TIP 0003 (RL-ER03)</p>
13	<p><i>Functional Performance Requirements:</i> The candidate materials will need to perform over a pH range of from 8 to 12. The material must be low in cost and should be abundant to avoid any attraction as a natural resource by future generations. The chemical distribution coefficient (K_d)</p>

	<p>should be greater than 100 mL/g. The trapping should be long-term and hence should not be easily reversible in the oxidizing environment at Hanford.</p> <p>Outsourcing Potential: Once the laboratories (PNNL and SNL) have performed the laboratory analysis and bench scale demonstrations, the technology will be available for field scale demonstration and deployment. Field scale demonstration and deployment will be outsourced. A number of geotechnical engineering firms that specialize in drilling and grouting are available to supply this expertise. "Landfill" closure of tank farms, i.e., by stabilizing tanks and residual tank waste with fill materials, could easily be outsourced. Incorporation of getters in tank fill materials is considered to be a routine part of such closure operations.</p>
	<p>** Schedule Requirements: Based on recent RCRA groundwater assessments, groundwater contamination in some locations has been attributed to tank system leaks. During FY 1999 additional borings were performed in the tank farms to assess inventory and distribution of contaminants in the tank farms vadose zone, and factors that have controlled contaminant movement. Contaminant transport modeling will then be conducted to estimate the benefits of corrective measures that could be employed. Emplacement of a reactive barrier is a corrective measure that may be selected if the technology has been demonstrated. To support future low-activity performance assessments, data is needed by September 2005. The results from the performance assessment will be used during the design of the waste package or disposal facility. To support the planned National Environmental Policy Act (NEPA) process for tank farm closure decisions, data is anticipated to be needed by the end of FY 2004. To support the remediation of other 200 area sites, information is needed by 2005.</p>
14	<i>Definition of Solution:</i> .
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i> Supports retrieval of potentially, leaking SSTs as well as disposal and closure activities.
17 *	<i>Potential Cost Savings:</i> Hundreds of millions of dollars
18 *	<p><i>Potential Cost Savings Narrative:</i> The cost savings could be significant. With regard to the disposal facility, the cost savings resulting from lowering the design requirements could exceed several hundred million dollars. The cost saving associated with deployment of the getter material in the soil could approach several hundred million dollars depending on the inventory and distribution of contamination resulting from past and anticipated future leaks (if contaminated soils would otherwise have to be removed to meet long term performance requirements for closed tank farms). The cost savings associated with placement of getter materials in tank fill materials as part of closure could approach several hundred million dollars, if higher levels of tank waste removal, or tank removal, would otherwise be required to meet long term performance requirements for closed tank farms.</p>
	<p>** <i>Technical Basis:</i> Deployment of sequestering agents directly in contaminated soil could provide an engineering solution for past leaks and retrieval leaks. Deployment of sequestering agents in the matrix or as a liner around the vitrified low-activity waste will reduce the engineering requirements of the disposal facility. Deployment of sequestering agents in tank fill materials, as part of tank closure operations, could enhance long term performance of the tank farm closure system.</p> <p><i>Other:</i> Concerns regarding the migration of contaminants from existing subsurface contamination and future leaks from sluicing could impact RPP/ORP retrieval options and limit cleanup and disposal strategies. Mitigation of waste immobilization will rely on the principle of chemical stabilization rather than macroencapsulation or containment.</p>

19	<i>Cultural/Stakeholder Basis:</i> Disposal of low-activity tank waste has the largest impact of any intentional Hanford disposal action. Deployment of the getter material as a reactive barrier in contaminated soil or in tank fill materials will reduce the rate of transport of contaminants to groundwater following tank farm closure, and will thereby reduce long term risk under postulated exposure scenarios that will be evaluated in making decisions on tank farm closure.
20	<i>Environment, Safety, and Health Basis:</i> Deployment of sequestering agents will reduce the long-term risk to both human health and the environment by attenuating the migration of mobile contaminants.
21	<i>Regulatory Drivers:</i> Performance assessments are required by DOE Order 435.1.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
23 *	<i>Material Streams:</i> 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	<i>TSD System:</i> 200 Area liquid discharge sites; ILAW disposal facility; SST farms; DST farms
25	<i>Major Contaminants:</i> Tc, I, Se, U, Np, Cr, CCl ₄
26	<i>Contaminated Media:</i> Hanford vadose zone
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2001
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> The current strategy for closure of Hanford double and single-shell tanks does not include the use of sequestering agents. Although the technology has been proposed for use in support of Environmental Restoration activities on the Hanford Site, the technology has not been deployed at Hanford. However, within the scientific community there is considerable interest in its potential use. The need for sequestering agent technology development has been identified in the ILAW program logic, and was evaluated as an option in Appendix F of the "Retrieval Performance Evaluation Methodology for the AX Tank Farm" (DOE/RL-98-72).</p> <p>Technology Insertion Point(s): TIP 0001 (RL-ER01), TIP 0002 (RL-ER02), TIP 0003 (RL-ER03)</p>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG., 509-372-9204, F/509-372-9447, Frederick_m_mann@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; Robert_w_Lober@rl.gov</p>
36 ***	<p><i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth_A_Ken_Gasper@rl.gov</p>

	A.F. (Anne-Marie) Choho, NHC, 509-509-372-8280, F/509-373-6382, Anne-Marie F Choho@rl.gov
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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Value of Information Decision Analysis for Tank Farm Closure
2 *	<i>Need Code:</i> RL-WT069
3 *	<i>Need Summary:</i> An approach is needed for determining when enough information on waste retrieval performance, closure technology, and vadose zone conditions has been gathered to support decisions on closure. Additionally, given the uncertainty associated with many of the parameters used in modeling waste site and closure scenario performance, it is important to develop and demonstrate capabilities for probabilistic modeling. Probabilistic modeling approaches support the conduct of sensitivity and uncertainty analyses and incorporate parameter distribution ranges. This helps to bound the risk analysis and determine where additional data or information is needed to reduce uncertainties in parameters that drive risk assessment outcomes.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Closure PBS No: RL-TW11
9 *	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> The Environmental Impact Statement (EIS) for the River Protection Project (formerly Tank Waste Remediation System) evaluated waste retrieval and disposal alternatives, but did not evaluate tank farm closure alternatives because sufficient information was not available. The Record of Decision for the EIS committed to conducting a NEPA process for decisions on tank farm closure, when sufficient additional information was available on waste retrieval performance, closure technology, and vadose zone conditions. The purpose of waste retrieval

from single-shell tanks (SSTs) is to prepare tanks for closure. Until decisions on closing tank farms are made, final requirements for SST waste retrieval cannot be specified. This includes requirements for allowable residual waste in SSTs following completion of retrieval. Unless a default value of zero leakage during retrieval is specified as an interim requirement, final requirements for leakage control during retrieval also are constrained by decisions on how tank farms will be closed, since closure decisions include decisions on remediation of soil potentially contaminated by retrieval leaks. Tri-Party Agreement milestones for characterizing the vadose zone in SST waste management areas (WMAs) under RCRA assessment have been established.

Phase 1 of the required investigations are scheduled to be completed in FY 2004, with recommendations for additional subsurface investigations that may be required to support decisions on waste retrieval and closure. Presently, criteria for making closure decisions (e.g., quantitative measure(s) of compliance, points of compliance, period of compliance, exposure scenarios) have not been finalized, although criteria are required to be established under the recently adopted Tri-Party Agreement milestones as a basis for determining what subsurface data should be collected. In addition, no criteria have been established to guide the decision due in FY 2004 on whether additional subsurface data may be needed in a second phase of subsurface investigations in the SST WMAs under RCRA assessment. Because subsurface investigations in contaminated tank farm soils are expensive, an approach is needed for determining when enough information has been gathered to support decisions on closure.

Furthermore, decision analysis is needed in support of alternative land use and regulatory modeling cases, including public information and polling studies to determine stakeholder acceptance of alternatives.

Many of the risk assessments conducted to date are performed in a deterministic manner using best knowledge of parameter values. In reality, the parameters have a fair amount of uncertainty due to the complicated nature of the tank wastes, release mechanisms, fate and transport, and overall environmental setting. Consequently, stochastic or probabilistic methods are needed in risk assessments to consider parameter sensitivities and uncertainties. Once parameter distribution ranges are determined, Monte Carlo modeling methods with Latin Hypercube sampling techniques, or other suitable modeling approaches, can be used to conduct probabilistic analyses. Such probabilistic analyses can also be useful in extrapolating data and information from one tank farm to another by demonstrating that the sensitive parameters fall within parameter distribution ranges.

Furthermore, decision support tools capable of probabilistic analyses can be used to evaluate alternative land use scenarios and regulatory modeling cases in support of defensible, risk based decisions. Such analyses can be used to provide a risk basis for developing consensus regarding approaches to site cleanup and closure that are protective of human health and the environment.

Consequences of Not Filling Need: Decisions on subsurface data collection and other data collection activities required in support of tank waste retrieval and closure decisions will be more arbitrary than necessary. More data may be collected at higher cost than is actually required for decision-making. Initiation of the closure decision process may be delayed longer than needed. More SST retrieval demonstrations may be conducted than are necessary for closure decision-making, with the increased risk that some may have to be re-retrieved in a second phase to meet final closure requirements. Decisions may be made to retrieve wastes when risk based decision analyses would support in-place isolation and stabilization of wastes with modifications to land use scenarios and regulatory framework, as appropriate and necessary.

<p>*** *** ***</p>	<p>Program Baseline Summary (PTS) No.: RL-TW11 Work Breakdown Structure (WBS) No.: 5.02.01.01.02.02 TIP No.: TBD</p>
<p>13</p>	<p><i>Functional Performance Requirements:</i> The decision analysis methodology will need to consider the value of gathering additional information on subsurface conditions, retrieval performance, and closure technology (relevance to their importance in selecting a tank farm closure alternative), and the cost of gathering such information. The decision analysis methodology will need to account for uncertainty, and the likely reduction in uncertainty that would result from gathering additional data. The decision analysis methodology will need to consider and make recommendations on alternative approaches to account for uncertainty, including expert elicitation. The decision analysis methodology will need to identify the closure decision-makers, and develop recommendations on how and when to involve the closure decision-makers in reaching consensus on the approach for determining when sufficient information has been gathered to reach the decision on proceeding with a NEPA process for closure.</p> <p>Decision support tools should also be used to compare land use scenarios, points of compliance, regulatory framework, and other considerations driving site remediation and closure decisions. The decision support tools must also be configured in a manner to support public, regulator, and stakeholder information by allowing “what if” scenarios to be run efficiently.</p> <p>Outsourcing Potential: Value of information decision analysis approaches have been developed and used successfully at other DOE Sites, national laboratories, universities, and in private industry for making capital investment decisions. Decision support tools have been successfully used by Sandia National Laboratories to license nuclear waste repositories such as the Waste Isolation Pilot Plant in Carlsbad, New Mexico.</p>
<p>***</p>	<p><i>Schedule Requirements:</i> The data quality objectives process and preparation of work plans for the Phase 1 site-specific subsurface investigations and retrieval system designs are planned over the period FY 1999 through FY 2005. Decision analysis methodology, if developed within this time frame, would provide input to definition of subsurface data needed during these Phase I investigations. At the latest, decision analysis methodology must be available for preparation of the RFI Report scheduled to be developed from late FY 2003 through the first half of FY 2004 to meet one of the recently adopted Tri-Party Agreement milestones. By this time, additional retrieval performance data should be available from planned retrieval projects at Hanford, as well as waste retrieval activities at other DOE sites. In addition, by this time additional information on tank closure technology should be available from closure activities at other DOE sites.</p> <p>Capabilities for sensitivity and uncertainty analyses are needed immediately in support of retrieval system designs. Retrieval release criteria and target leak detection rates are determined by the RPE Methodology. The RPE Methodology is currently a deterministic, risk-based method that considers past tank leaks, potential leakage losses during retrieval, and residual waste inventories. All of these considerations have uncertainties associated with waste inventories, release mechanisms, fate and transport, and other considerations that are modeled in the risk assessment.</p> <p>Decision support tools capable of modeling alternative land uses and regulatory cases are needed immediately in support of site cleanup and closure decisions to ensure cost-effective actions that are risk based. Furthermore, these tools can be used effectively in support of public, regulator, and stakeholder information to understand the minimum necessary to adequately protect human</p>

	health and the environment.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$350,000,000
18 *	<p><i>Potential Cost Savings Narrative:</i> Phase 1 of the planned investigation of SST WMAs under RCRA assessment is estimated to cost in excess of \$30 million over the period FY 1999 through FY 2004. A subsequent phase to gather additional subsurface information can be expected to cost a comparable amount. Retrieval costs per SST to satisfy the M-45 Series of Tri-Party Agreement milestones can be expected to cost on the order of \$20-\$30 million per tank. If a second or third phase of subsurface investigations can be avoided based on application of value of information methodology, or focused on only that information needed for decision-making, the savings could be on the order of tens of millions of dollars. Similarly, if closure decisions can be supported after only a small number of SST retrieval demonstrations, tens of millions of dollars per SST can potentially be saved in retrieval of residual waste remaining after completion of retrieval demonstration in the event closure requirements that were ultimately established turn out to require more extensive retrieval than was accomplished during the retrieval demonstrations. Furthermore, if waste retrieval is required only to the extent indicated by a probabilistic risk-based evaluation for closure, then savings on the order of \$5 million per tanks can be realized for roughly 70 tanks that are essentially empty or contain special case wastes (lower than Class C).</p>
**	<p><i>Technical Basis:</i> A quantitative approach is needed for determining when sufficient data is available to proceed with the required NEPA process for tank farm closure, i.e., a methodology is needed for determining when gathering additional information is unlikely to change the decision. Value of Information (VOI) approaches will quantify the expected value of additional information that is relevant to closure decisions, and will provide a defensible methodology for prioritizing characterization work and optimizing retrieval system and site closure designs. Thus, it will not only be possible to know when it is no longer cost effective or necessary to gather additional information for closure; it will also enable managers to identify what characterization activities are most cost effective for improving the quality of RPP decisions that impact closure. Thus, VOI also becomes a valuable adjunct to planning a cost effective characterization program.</p> <p>Other: There are no current commitments to DOE to perform value of information decision analysis as a basis for determining when sufficient information is available to proceed with a NEPA process for closure. However, DOE's Record of Decision for the RPP EIS that committed to proceeding with a closure decision process when sufficient information is available implies a requirement for application of decision analysis methodology in order to determine when in fact sufficient information is available.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Expressed stakeholder values include adopting a systems approach in cleanup decisions, and getting on with waste retrieval and closure in a timely manner that protects human health and the environment. Value of information decision analysis methodology will help to focus expensive data gathering activities on retrieval and closure decision-making, and will help decision-makers recognize when enough information has been gathered to make those decisions. Such an approach is advocated by the Columbia River Comprehensive Impact Assessment, prepared by representatives of regulators, Tribal Nations, and stakeholder groups, to focus data gathering efforts based on system elements determined to</p>

	be “dominant”.
20	<i>Environment, Safety, and Health Basis:</i> The NEPA process for making evaluating alternatives and making decisions on tank farm closure will consider health and safety impacts to workers and the public from routine operations and accidents. The value of information decision analysis methodology will need to also address when sufficient information is available to evaluate worker and public health and safety impacts.
21	<i>Regulatory Drivers:</i> The Record of Decision for the RPP EIS (62 FR 8693) requires a decision to proceed with a NEPA process for tank farm closure, when sufficient information is available. Tri-Party Agreement Milestone M-45-55 requires preparation of an RFI Report with recommendations on the need for additional subsurface investigations to support decisions on waste retrieval and closure. The Change Control Form (M-45-98-03) for these Tri-Party Agreement milestones requires determination that no additional subsurface information is needed prior to conducting a NEPA process for closure, which must be completed prior to preparing a tank farm Closure Plan. Tri-Party Agreement milestone M-45-06-T01 requires preparation and submittal of a RCRA closure plan that must be approved prior to initiation of closure activities. Tri-Party Agreement milestone M-45-06 requires closure of SST farms over the period FY 2012 through FY 2024. The interim and target Tri-Party Agreement milestones under M-45-03 and M-45-04 require demonstration of retrieval technology first in a tank (C-106), and subsequently in a tank farm or equivalent number of tanks to provide the basis for finalizing a retrieval performance requirement for closure. The M-45 Series of TPA milestones also call for the preparation of Functions & Requirements (F&Rs) in support of retrieval and LDMM system designs. Retrieval Performance Evaluation (RPE) Methodology calculations are performed in support of F&R documents to determine risk-based retrieval release criteria and target leak detection rates as a function of past tank leaks, potential leakage losses during retrieval, and residual wastes inventories.
22	* <i>Milestones:</i> T04-01-W21, M-45-55-T01, M45-55-T02, T04-04-W18, T04-04-W19, T04-18-1B1, T04-24-051, T04-24-052
23	* <i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20) ID-3857 HLW to Treatment Risk Score: 3
24	* <i>TSD System:</i> Single Shell Tank Systems
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tanks wastes consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge, and vadose zone soils.
27	<i>Volume/Size of Contaminated Media:</i> Nominal capacities of the tanks is 55,000 to 1,000,000 gallons. 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	* <i>Earliest Date Required:</i> 9/30/01
29	* <i>Latest Date Required:</i> 9/30/06
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Value of information decision analysis approaches have been used successfully at other sites, including for example at the Waste Isolation Pilot Plant to make decisions on continuation or termination of planned R&D efforts that constrained license application for the repository. Current risk assessment approaches use deterministic methods with single “best-basis” values. In reality, sensitive parameters are uncertain with parameter

	distribution ranges. Capabilities for probabilistic analyses allow uncertainties to be captured and factored into analyses in support of retrieval and closure decisions. Technology Insertion Point(s): N/A
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> T.L. (Terry) Sams, CHG, 509-373-0417, F/509-372-3983, Terry L. Sams@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov
36 *	<i>Other Contacts:</i> J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry W Cammann@rl.gov ; K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Advanced Characterization Tools for Contaminants of Concern
2 *	<i>Need Code:</i> RL-WT102
3 *	<p><i>Need Summary:</i> The extent of contamination in soil, burial ground, and tank farm sites is often poorly defined. A cost-effective technology that provides real-time, in situ measurement of radioactive (technetium, uranium, plutonium, strontium-90, iodine, and selenium) and hazardous (chromium, mercury, lead, nitrate, sodium) contaminants of concern in soils at depth is required to better define the contaminant plume boundaries prior to remediation and also to support long-term monitoring for performance validation of the completed remediation activity. Similarly, a cost-effective technology for in-tank determination of concentrations of contaminants of concern (carbon-14, selenium-79, technetium-99, iodine-129, uranium-238, americium, curium, niobium, neptunium, plutonium, tin, thorium, nitrate, nitrite, and chromate) would provide better tank waste characterization, would facilitate efforts to demonstrate that tank waste retrieval objectives have been received, and would accelerate closure efforts.</p> <p>A similar Need Statement has been submitted to both the Subsurface Contaminants and Tank Focus Areas in Spring 2000.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Closure and Safe Storage <i>PBSNo:</i> RL-TW03, RL-TW11
9 *	<p><i>National Priority:</i> The four major core projects of the Hanford Site Groundwater / Vadose Zone Integration Project (200 Areas Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) agree that this is the Hanford Site's second most important science and technology need.</p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> 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</p>

	<p>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.</p> <p>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.</p> <p>Safe storage, retrieval, and closure activities associated with SST wastes are also supported by Special Projects and Vadose Zone Projects to characterize groundwater flow and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes. Understanding of tank waste inventories is critical to successful retrieval and LDMM system designs.</p>
12	<p><i>Need/Problem Description:</i> Fifty years of defense plutonium production resulted in the creation of a large number of solid waste burial ground sites in the Hanford Site's 100, 200, and 300 Areas. The 100 Areas are located along the Columbia River and include nine nuclear reactors previously used for plutonium production. The 300 Area also is located along the Columbia River and contains the fuel fabrication facilities. The 200 Area is located on the central plateau and contains the spent fuel extraction and processing facilities and the radioactive waste storage tanks. The Hanford Site's burial grounds contain drummed waste and a variety of solid waste debris including construction waste, discarded equipment, and protective clothing. Much of this waste is contaminated with low-level radioactive materials. The baseline for the 100 and 300 Area sites is excavation and disposal on site. The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or barrier placement strategies. Non-intrusive or minimally intrusive investigation and determination of burial ground contents will aid the development of remedial action plans and will reduce exposure to workers involved in removal operations. This enhanced characterization information may potentially be useful in avoiding contract modifications during remediation activities. In addition, these tools also may be necessary to support decisions to leave some burial grounds in place with caps or other measures to control exposures. Leaving selected 100 and 300 Area burial grounds in place could result in cost savings of over \$500M. Improved detection techniques would also allow for hot spot/selective removal alternatives and help locate soil sites covered with clean fill material.</p> <p>At present, gross burial ground delineation and assessment is accomplished with various remote sensing instruments, including ground-penetrating radar, magnetic anomaly detection, and remote roving vehicles to measure gamma ray emissions. These methods are effective to identify certain types of debris, contaminants, and changes in subsurface conditions. For example, ground-penetrating radar effectively detects physical objects that present a distinctly different reflectivity from the surrounding matrix, such as metal drums or pipes. However, burial ground excavation experience this past year showed that current techniques were not able to conclusively identify large areas of drummed waste in two separate burial grounds. The remote measurement of gamma radiation can identify the presence of certain radionuclides that are high-energy gamma emitters, such as cobalt-60. Other radioactive contaminants, such as strontium-90 and uranium, are beta- and alpha particle emitters that cannot be detected with surface remote detection because of matrix interference of the overlying soils. Some of these non-gamma emitters can be inferred</p>

<p>from analog measurements using electrical resistivity techniques. Electrical conductance or resistance can be monitored using tomographic methods to obtain three-dimensional images of the subsurface. Other methods, including more standard geophysical resistivity monitoring, might also be applicable and in some cases electromagnetic induction techniques might be deployable at selected waste sites (at areas of low metal content). Where even moderate salt concentrations slightly above background are present in the subsurface, these methods may prove to be reliable in capturing the shape and movement of the subsurface radioactive plumes that have leaked from cribs and trenches at the Hanford Site.</p> <p>The approximate total volumes of soil requiring remediation at the Hanford Site (liquid waste disposal sites and burial grounds) are: 3.9 million cubic yards in the 100 Areas, approximately 10 million cubic yards in the 200 Areas, and 0.8 million cubic yards in the 300 Area. The 100 Area has over 340 contaminated soil sites that are expected to require remediation. Soil units include cribs, French drains, trenches, ponds, and retention basins that received radiologically and chemically contaminated liquid effluent from reactor and support operations. Cobalt and strontium-90 are the main radioactive contaminants of concern. The 300 Area has several soil sites that resulted from liquid disposal in ponds and trenches. Uranium is used as an indicator contaminant and soils with concentrations greater than 350 pCi/g in the top 15 feet are removed. The 200 Area contains approximately 1,000 different soil and burial ground sites. Soil waste sites are predominantly the result of liquid discharges to cribs, ponds, and ditches. The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or barrier placement strategies. The target/indicator contaminants will be developed for the 200 Area as part of the characterization activities. However, technetium, plutonium, uranium, cesium, cobalt, and strontium are likely to be the key indicator contaminants for many of the contaminated sites.</p> <p>The boundaries for some of these liquid waste disposal sites are poorly defined. Also, other sites may have significantly different contaminant concentrations throughout the site. The baseline strategy for soil sites in the 100 and 300 Areas is to excavate the top 15 feet of contaminated soil and dispose on Site. Portions of the 200 Area sites are also anticipated to be excavated and disposed on Site. If contamination extends beyond 15 feet, soil contaminant concentrations and/or mobilities must be low enough to prevent future groundwater problems. If concentrations exceed these levels, additional remedial measures (removal, containment, or treatment) may be required. In situ detection techniques would help make this determination prior to excavation and potentially be useful in avoiding costly contract modifications necessary if this contamination is not discovered until after excavation has started. In situ characterization technologies may also help support cost-effective means of making closure decisions, including assessing the potential release possible from tank residuals.</p> <p>From the SST perspective, 67 of Hanford's 149 SSTs are known or suspected to have leaked roughly 1,000,000 gallons of high-level waste into the surrounding vadose zone soils. Although no additional SSTs are known to be leaking at this time, all of the SSTs have exceeded their intended design lives and continue to degrade. Pumpable liquids have been, and are being, removed from the SSTs through the Interim Stabilization Project saltwell pumping activities. Furthermore, retrieval systems are being designed to use very little, if any, liquids to dislodge, mobilize, retrieve, and transfer the wastes into newer double-shell tanks. Liquids used to facilitate tank waste retrieval operations will be introduced in a confined and controlled manner.</p> <p>At present, two cores are typically extracted from a tank, extruded in the laboratory, and are analyzed in accordance with applicable Data Quality Objectives (DQOs). These core samples are</p>

supplemented by grab, vapor, and other samples. Although this level of sampling and analyses is considered the best that can be done at present, questions regarding sample representativeness exist due to incomplete core recoveries, heterogeneities in waste layers and composition, limited riser locations, relative volume of samples versus tank waste volumes, and other considerations. Furthermore, core sample collection and analysis is relatively expensive at \$750K to \$1,000K per core. Better in situ characterization techniques for previously mentioned contaminants of concern could have a high return on investment in terms of reduced sampling and analysis costs, and better tank waste inventories in support of retrieval and LDMM system designs. In situ characterization could also be used in support of evaluating ancillary piping and other equipment, as well as characterization of tank waste residuals and contaminants in soils in support of tank farm closure planning and execution. A key consideration in performing better in situ characterization of tank wastes is providing capability for off-riser sampling and analyses. It is also important to determine interstitial liquid volumes and associated inventories of contaminants of concern. Potentially applicable technologies include, but are not limited to, in-tank spectral gamma techniques, in situ beta time-of-flight measurement techniques, and pressure transducer technologies from the petroleum industry.

Consequences of Not Filling Need: Continued use of current methods that includes costly boring, labor-intensive sampling, and laboratory analysis. From a SST retrieval and closure perspective, it will be difficult to demonstrate that retrieval goals and closure requirements are met without capabilities for cost effectively performing in situ characterization of tank waste residuals that may not be located directly beneath a tank riser. The consequences of this, include the possibility of a secondary retrieval operation to attempt to remove tank waste residuals. This could require the development and demonstration of alternative retrieval technologies for tank waste residuals.

*** Program Baseline Summary (PBS) No.: RL-TW03, RL-TW11
 *** Work Breakdown Structure (WBS) No.: 5.05.01.01, 5.01.03.06.02
 *** TIP No.:

- 13 *Functional Performance Requirements:* The cost-effective technology needs to provide real-time, in situ measurement of radioactive contaminants with field-deployable instruments. Data must be easily downloaded into computer systems for analysis and retrieval. Detection limits down to required remediation levels or levels at which remediation alternative decisions can be made would be preferable, but higher detection-level instruments that could be deployed economically at depth are also of interest. If possible, the technique should support the eventual elimination of the requirement for sample collection and analysis. Remediation goals can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17) and are displayed in the following table. The 200 Area sites do not currently have specific remediation goals, but goals are anticipated to be no more stringent than the ones presented for the 100 Area sites.

Table I: Remediation Goals			
Radioactive Material	(pCi/g)	Hazardous Material	mg/kg
Technetium	15.	Cr (VI)	2.2
U-233/234	1.1	Mercury	24
U-235	1.0	Lead	353
U-238	1.1	Nitrate	30 ^a
Pu-238	37.4	Sodium	25 ^a
Pu-239/240	33.9		
Sr-90	4.5		

^a Based on ratio to Cr observed in 41-09-39 borehole in SX tank farm

	<p>Three distinct zones are of distinct interest: 0-20 feet; 20 - 80 feet, and 80 - 300 feet. In the first zone, penetrations will be by cone penetrometer or other direct push technology. Retrieved samples from the first zone will be obtained from excavation or from cone penetrometer pushes. Penetrations into the second zone will be done by cone penetrometer, new borehole, or existing steel-encased boreholes. The size of samples from the second zone will vary depending upon the method of retrieval (ranging from 50 grams to nearly continuous core up to 4 inches in diameter). Penetrations in the deepest zone can only be done with steel-encased boreholes. There are relatively few boreholes extend below 120 feet.</p> <p><i>Outsourcing Potential:</i> Potentially high.</p> <p><i>How Long It Will Take:</i> The remediation and tank closure effort is ongoing and will last for at least the next 30 years.</p>
**	<p><i>Schedule Requirements:</i> Support Tank Waste Closure Work Plan 2004 Update. Soil Remediation and 200 Area site characterization activities are ongoing. Goals established in the Hanford Ten-Year Challenge would have all soil sites and burial grounds in the 100 Area and 300 Area completed by 2006. Characterization and remediation of the 200 Area began in FY 1999 and will extend several years past 2006. Tank farm characterization is ongoing with planning for remedial action and closure having started. The first tank farm is scheduled to be closed by 2014 under the Tri-Party Agreement with initiation of the closure demonstration in the 2012 time frame.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$50,000,000 (TW11 only)
18 *	<p><i>Potential Cost Savings Narrative:</i> Substantial cost savings could result if select burial grounds and portions of soil sites could be treated in place instead of excavated and disposed of. Substantial cost savings could result if site characterization activities can be performed without the need to conduct full-suite laboratory analyses on soil samples.</p> <p>Unexpected waste found during excavation of the first two burial grounds at the Hanford Site have led to unplanned delays and increased costs of nearly \$1M over the planned budget. Preventing these delays for the 45 to 100 buried wastes sites that may eventually require excavation would result in significant cost savings.</p> <p>Current costs to extract and analyze core samples from SSTs ranges from \$750K to \$1,000K per core, and two cores are typically extracted from each tank. Better in situ characterization methods could greatly reduce the costs associated with tank waste characterization. Furthermore, defensible methods for in situ characterization could save tens of millions of dollars per tank by demonstrating that tank waste residuals do not exceed risk guidelines and may be disposed of in-place without additional removal and treatment.</p> <p>This need is targeted at obtaining information that will help develop a better understanding of the Hanford Site contamination. This understanding will be used to determine appropriate solutions to these contamination problems. These solutions may offer a cost savings potential over solutions selected based on the current more limited knowledge of contaminant distribution and migration potential at the Site.</p>

19	<p><i>Cultural/Stakeholder Basis:</i> Measurement data will have better credibility with the oversight panels when the measurement methodology has been peer-reviewed and accepted. Issues concerning emissions from the pretreatment and vitrification processes should be answerable with documented data. Stakeholders have expressed serious concerns that inadequate waste site characterization will be used to support decisions to leave waste in place.</p> <p>Better understanding of residual waste inventories through in situ characterization will provide stakeholders with information required to support in-place isolation and stabilization decisions; including the selection of appropriate site closure technologies to ensure adequate protection of human health and the environment over time frames of concern.</p>
***	<p><i>Technical Basis:</i> Accurate and easily operated instrumentation to measure the concentrations of radioactive contaminants in situ will facilitate accurate remedial alternative decision making as well as soil remediation and tank farm planning. In situ techniques will also reduce exposure to workers involved in characterization work.</p>
20	<p><i>Environment, Safety, and Health Basis:</i> Successful detection and delineation technologies could reduce risk to remediation workers by negating the requirement for invasive sampling to adequately characterize burial grounds or the contents of liquid waste sites. These technologies also will reduce the chances of excavation workers encountering unexpected items that require work stoppages and upgrades in personnel protective equipment.</p> <p>Better abilities to perform in situ characterization of tank waste contents will facilitate efforts to conduct defensible risk based tank waste retrievals. From a final tank farm closure perspective, the ability to perform defensible in situ characterization of tank waste residuals is important to proper selection and implementation of surface barriers, subsurface barriers, reactive zones, sequestering agents, and other technologies required to immobilize tank waste residuals and ensure protection of human health and the environment.</p>
21	<p><i>Regulatory Drivers:</i> Analyses completed as part of the effort to address this technology need will serve as the basis for reaching agreement with regulatory agencies on establishing performance objectives and criteria for remediation and closure of Hanford facilities; including the retrieval of tank wastes. Also, information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. In addition, capability to collect this information would also be useful to support selection and monitoring of effective remediation alternatives and final closure schemes.</p>
22 *	<p><i>Milestones:</i> T04005-W18 – Submit a Corrective Measures Study (TW04), TPA M-45 Series Milestones T09-06-100 – M90-10 CD-4 Initiate Hot Operations W-520 (TW09)</p>
23 *	<p><i>Material Streams:</i> Soil (Disposition Map Designations: ER-04: LLW Soils 100/300 Area, ER-14: LLW Soils 200 Area, ER-03: MLLW Soils) ID-2119 LAW Glass Risk Score: 3 (shown in WT09) RL-HLW-20 Sludge, salt, liquid</p>
24 *	<p><i>TSD System:</i> Single Shell Tank systems. ILAW (TW09) will be disposed in trenches.</p>
25	<p><i>Major Contaminants:</i> Pu-238, 239, 240, 241; AM-241; U-238; C-14; N-59/63; Nb-94; Tc-99; I-129; Cm-242; Sr-90; Cs-137; Sn-126; Se-79; chromium; nitrate; nitrite; complexants (EDTA/HEDTA)</p>
26	<p><i>Contaminated Media:</i> Drill cuttings and laboratory waste, tank wastes consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.</p>

27	<i>Volume/Size of Contaminated Media:</i> SSTs have leaked roughly 1,000,000 gallons of high-level waste into the vadose zone. The SSTs currently contain roughly 33,000,000 gallons of saltcake, sludge, and supernatant wastes. 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 *	<i>Earliest Date Required:</i> 9/30/01
29 *	<i>Latest Date Required:</i> 9/30/03
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> Borehole, cone penetrometer, cased wells and test pits are used to gain access to the subsurface. A sensitive hyper-pure germanium gamma detector adapted for borehole use gathers radiation spectrums as it is lowered through a casing. Soil samples from the drill cuttings are sent to laboratories for analyses.</p> <p>Core, grab, and vapor samples are currently collected from SSTs and are analyzed. Typically two core samples are extracted from each tank from available risers. In some cases, these core samples represent 1/1,000,000th of the tank waste volume. Sample representativeness is further compromised by incomplete core recovery, heterogeneities in waste layers and composition, and limited riser locations.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i> Varied. Baseline characterization activities in the 200 Areas are estimated to be \$70M.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG, 509-372-9204, F/509-372-9447, Frederick m mann@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov</p>
36 ***	<p><i>Other Contacts</i> J.W. (Jerry) Cammann, CHG, 509-372-2757, F/509-373-6101, Jerry W Cammann@rl.gov K.A. (Ken) Gasper, CHG, 509-373-1948, F/509-376-1788, Kenneth A Ken Gasper@rl.gov</p>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

INITIAL QUANTITY

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Advanced/Improved Vitrification
2 *	<i>Need Code:</i> RL-WT080
3 *	<i>Need Summary:</i> Current baseline HLW vitrification technology imposes limitations to glass waste loading resulting in increased glass volumes and resultant number of HLW canisters. The current baseline LAW vitrification technology requires very large melters with key components, that require frequent replacement. Both the HLW and LAW melters also create significant solid waste disposal issues due to their size and disposal requirements. Alternative or advanced technologies have not been evaluated to determine their ability to significantly reduce life-cycle production and disposal costs. Concurrent evaluation and demonstration of HLW and LAW glasses that can achieve higher waste loadings or durable crystalline phases also need to be performed. This need includes higher temperature joule heated melters, cold wall or cold crucible melters, and higher waste loading techniques; i.e., dealing with problem constituents. (See J.Ahearne et al., "High-Level Waste Melter Review Report", TFA-0108, July 2001).
4 *	<i>Origination Date:</i> FY 2001 (October 18, 2001)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: ORP-TW06LT
9	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> X </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> Borosilicate glass was selected in 1982 as the preferred waste form for defense high-level waste disposal in the federal geologic repository. In the same time period the joule-heated ceramic melter was selected as the preferred U.S. DOE vitrification technology. The Hanford River Protection Project is proceeding with the design and construction of the Waste Treatment Plant for high-level and low-level waste vitrification. Under the current schedule, it is required that well-defined borosilicate waste forms and joule-heated melter technology designs be selected. Even though the current technology baseline incorporates some improvements, significant increases in waste loading and glass volume reduction are achievable if advanced waste form development and/or alternative technology can be shown to meet the WTP requirements. Specific to Hanford HLW, relatively high levels of iron, aluminum, chrome/nickel, zirconium, and phosphate (to a limited extent) individually or in combination restrict waste loadings in

	<p>borosilicate glasses melted at 1,150°C. Exceeding solubility limits for these components results in crystal formation which must be prevented from occurring in the current technology. In a majority of glass compositions, it is this processing constraint that limits glass waste loading and, therefore, defines the quantity of glass canisters that will be produced.</p> <p>Specific to Hanford LAW, waste constituents that have only limited solubility in the current glass formulations will dictate waste loading. These minor constituents include sulfate, chloride, fluoride, chromium and phosphate. Waste loading limitations will define the quantity of ILAW produced. In addition, the number of vitrification units and production and availability requirements could also be affected. Sulfate has the largest possible effect on glass volume production. Due to the high sodium content of the LAW higher-temperature processing is not very practical. In this case, alternative glass and glass/crystalline forms and melters capable of producing them are preferred options. Additional and potentially more important issues with LAW processing are the melter size, high maintenance requirements, and disposal volumes. More compact, high-capacity, reliable technology resulting in minimal solid waste is the optimum solution.</p>
13	<i>Functional Performance Requirements:</i> The alternative technologies need to reduce the overall life-cycle cost for production and disposal of vitrified HLW glasses.
14	<i>Definition of Solution:</i> Acceptable solutions will be achieved for each of the requirements when waste forms have been developed and demonstrated to meet the requirements, and vitrification technologies have been evaluated and demonstrated at glass production scales of about 1 t/d for IHLW and 5 t/d for ILAW.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<i>Potential Benefits:</i> Primary technical benefits include increased plant operating performance and a relaxation in waste/waste form composition constraints. Insertion of improved technology prior to Phase 2 operations could avoid the construction of a second LAW vitrification facility and avoidance of operating and contaminating a second IHLW vitrification cell. Operating costs would be reduced through increased on-line efficiency and reduced solid radioactive waste volumes.
17	<i>Potential Cost Savings:</i> A DOE EM-40 study has estimated that life-cycle HLW cost savings of between \$1.9B and \$4.3B could be achieved by increased waste loading and reduced canister production. LAW vitrification cost savings would include avoidance of ~\$520M in capital construction costs for a second facility plus reduced operating and ILAW disposal costs.
18	<i>Potential Cost Savings Narrative:</i> With the WTP annual operating cost expected to be in the hundred's of millions of dollars, minimizing plant start up or down time will be a key potential savings, easily measured in the tens of millions of dollars. Because the cost of disposing a single canister of HLW at the national deep geologic repository is expected to cost several hundred thousand dollars, process improvements that increase waste loading or reduce the amount of non-HLW constituents going into the HLW canister have a significant payback by reducing the number of canisters that must go to the repository. This savings is measured in the hundreds of millions of dollars.
19	<i>Technical Basis:</i> Current baseline technology requires waste forms to be produced with reduced waste loadings as a compromise to the technology. Resolution of this need may increase WTP flexibility and technical and economic performance.
20	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.

21	<i>Environment, Safety, and Health Basis:</i> Reduced IHLW and ILAW packages reduce the risks to workers and the environment. Reduced operating periods will reduce worker exposure and a reduced facility life.
22	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
23	<p><i>Milestones:</i></p> <p>November 15, 1999 tri-party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Retrieve all SSTs 2018 • Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
24	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
25	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
26	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
27	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge.
28	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
29 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is in support of WTP permitting.
30 *	<i>Latest Date Required:</i> 10/2007 To support Phase 2 operations a FY 2008 completion date will be required.
Baseline Technology Information	
31	<p><i>Baseline Technology/Process:</i> The current technology is a joule-heated melter that operates at a nominal temperature of 1,150°C and employs bubblers to increase production rates. Current technology will produce an estimated 12,200 canisters (14,000 m³) of IHLW and 72,000 containers (185,000 m³) of ILAW. Plant operations will be completed between 2028 and 2040.</p> <p><i>Technology Insertion Point(s):</i> N/A</p>
32	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion.

33	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
34	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
35	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Steve Barnes, River Protection Project – Waste Treatment Plant, Research and Technology – Vitrification Technology, P/509-371-5127, F/509-371-5163, email: smbarnes@bechtel.com
36	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo Rudy Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie M Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E J Cruz@rl.gov
37 *	<i>Other Contacts</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Anti-foaming Agents for Evaporation of Alkaline Wastes
2 *	<i>Need Code:</i> RL-WT086
3 *	<i>Need Summary:</i> Evaluate additives that inhibit and/or reduce foaming of alkaline wastes during evaporation.
4 *	<i>Origination Date:</i> FY 2001 (October 18, 2001)
5 *	<i>Need Type:</i>
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: ORP-TW06LT
9	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> X </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> The alkaline liquid fraction of the tank wastes contains varying quantities of aqueous soluble organic compounds such as oxalate, formate, citrate, EDTA, and HEDTA. Evaporation of these waste solutions can lead to foaming and increased entrainment of radionuclides and hazardous waste constituents into the evaporator overheads, causing the overheads to exceed waste acceptance criteria at effluent treatment facilities. Additionally, efforts to address foaming are likely to negatively impact process throughput.
13	<i>Functional Performance Requirements:</i> Efforts to address foaming must not negatively impact process throughput. Should defoamers be utilized, defoamer must be effective in the parts-per-million dose range, be easy to meter for use, and be safe for industrial type handling with a minimum of personnel protection needed.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<i>Potential Benefits:</i> Reduce risk that evaporator overheads exceed waste acceptance criteria at effluent treatment facilities. The major benefit of these facilities is to ensure that the WTP starts up and operates according to plan and schedule: processing the various wastes in the quantities expected.
17	<i>Potential Cost Savings:</i>
18	<i>Potential Cost Savings Narrative:</i>
19	<i>Technical Basis:</i> Antifoaming agents have been used extensively at the Hanford Site and Savannah River Site to inhibit foaming during the evaporation of alkaline tank waste solutions. However, the chemistry of these waste solutions is modified in the WTP due to the addition of recycle solutions from the vitrification off-gas treatment systems.

20	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
21	<i>Environment, Safety, and Health Basis:</i> Failure to mitigate foaming could possibly impact the release of constituents of concern into off-gas system.
22	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
23	<p><i>Milestones:</i></p> <p>November 15, 1999 tri-party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase I Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Retrieve all SSTs 2018 • Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
24	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
25	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
26	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
27	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge.
28	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
29 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is in support of WTP permitting.
30 *	<i>Latest Date Required:</i> 11/2009 Support Hot Commissioning (which must be completed in 12/2007) and subsequent operation leading to Commercial Operation (which must be started by 12/2009).
Baseline Technology Information	
31	<i>Baseline Technology/Process:</i>
32	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself in the \$4 billion range. The current River Protection Project

	(formerly known as Tank Waste Remediation Systems) life cycle costs are estimated at approximately \$50 billion.
33	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
34	<i>Completion Date Using Baseline:</i> Currently there is large uncertainty in the WTP life-cycle cost, and it will be revised after the new Design and Construction contractor is put under contract early in FY2001.
Points of Contact (POC)	
35	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Reid Peterson, River Protection Project – Waste Treatment Plant, Research and Technology – Pretreatment Technology, P/509-371-5128, F/509-371-5163, email: rpeterso@bechtel.com
36	<i>DOE End User POCs:</i> N R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo Rudy Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie M Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E J Cruz@rl.gov
37 *	<i>Other Contacts:</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Improved Separation Agents and Processes to Remove Cesium from Supernatant Solutions
2 *	<i>Need Code:</i> RL-WT092
3 *	<p><i>Need Summary:</i> By separating the radioactive and long-lived compounds from the HLW-tank supernatants, the solutions could be disposed of as LAW after treatment. Such separation technology would reduce the disposal cost. Current technologies include ion exchange and precipitation.</p> <p>Despite advances in separation technology (i.e., SuperLig 644 for cesium separation and SuperLig639 for technetium separation), improvements to processing rates, sorbent capacity, column performance, sorbent degradation, sorbent stability, and manufacturing scale-up are needed to minimize capital, operating and disposal costs.</p>
4 *	<i>Origination Date:</i> FY 2001 (October 18, 2001)
5 *	<i>Need Type:</i> Technology
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: ORP-TW06LT
9	<p><i>National Priority:</i></p> <p>☐ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>☒ 2. <u>Medium</u> - 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).</p> <p>☐ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i>
13	<i>Functional Performance Requirements:</i>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> The major benefit is to ensure that the WTP starts up and operates according to plan and schedule: processing the various wastes in the quantities expected
17	<i>Potential Cost Savings:</i>
18	<i>Potential Cost Savings Narrative:</i>
19	<i>Technical Basis:</i> Testing of the reference cesium and technetium ion exchange material, SuperLig 644 and SuperLig 639 resins respectively, is ongoing and will not be completed for several years. Although results to date do not indicate any fault with this material,

	manufacturing scale up and additional testing of SuperLig 644 and 639 resins remain to be completed.
20	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
21	<i>Environment, Safety, and Health Basis:</i>
22	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
23	<p><i>Milestones:</i></p> <p>November 15, 1999 tri-party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Retrieve all SSTs 2018 • Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
24	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
25	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
26	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
27	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge
28	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
29 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is in support of WTP permitting.
30 *	<i>Latest Date Required:</i> 11/2009 Support Hot Commissioning (which must be completed in 12/2007) and subsequent operation leading to Commercial Operation (which must be started by 12/2009).
Baseline Technology Information	
31	<i>Baseline Technology/Process:</i>
32	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars,

	with the BNI estimate itself in the \$4 billion range. The current River Protection Project (formerly known as Tank Waste Remediation Systems) life cycle costs are estimated at approximately \$50 billion.
33	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
34	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
35	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Reid Peterson, River Protection Project – Waste Treatment Plant, Research and Technology – Pretreatment Technology, P/509-371-5128, F/509-371-5163, email: rpeterso@bechtel.com
36	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo Rudy Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie M Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E J Cruz@rl.gov
37 *	<i>Other Contacts:</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1	<i>Need Title:</i> Filtration Optimization and Process Enhancement
2	<i>Need Code:</i> RL-WT093
3	<p><i>Need Summary:</i> A filtration step is currently designed to protect the ion exchange beds from loading with particles and is used to concentrate solids during leaching steps. There are several possibilities for improving the process and the filtration operation. Process enhancement will benefit from an increased understanding of the parameters that are important for dewatering. The following are areas that have the potential for improving the process:</p> <ul style="list-style-type: none"> • Changing processing parameters such as flow rates, cross membrane pressure, backflow pulses, filter elements, etc. • Understanding waste chemistry effects. For example, there appears to be a point that too much leaching leaves the remaining solids very difficult to filter. Other constituents such as dissolved organics also appear to influence filtration. • Obtain operational understanding and establish procedures to ensure maximum throughput – filter cleaning, back pulsing, scouring, filter fouling, etc.
4	<i>Origination Date:</i> FY 2001 (October 18, 2001)
5	<i>Need Type:</i> Technology
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: ORP-TW06LT
9	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i>
13	<i>Functional Performance Requirements:</i>
14	<i>Definition of Solution:</i>
15	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<i>Potential Benefits:</i> The major benefit is to ensure that the WTP starts up and operates according to plan and schedule: processing the various wastes in the quantities expected.
17	<i>Potential Cost Savings:</i>
18	<i>Potential Cost Savings Narrative:</i>
19	<i>Technical Basis:</i> Testing of the reference ultrafiltration system using 0.1-µm, sintered-metal filters,

	is ongoing and will not be completed for several years. Although results to date do not indicate any fault with this filtration process, additional testing remains to be completed. Evaluating enhancements to the solids-liquid filtration process could improve plant throughput.
20	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
21	<i>Environment, Safety, and Health Basis:</i>
22	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
23	<p><i>Milestones:</i></p> <p>November 15, 1999 tri-party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase I Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Retrieve all SSTs 2018 • Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
24	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase I Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
25	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
26	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
27	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge.
28	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
29	<i>Earliest Date Required:</i> 11/2002 The earliest date required is in support of WTP permitting.
30	<i>Latest Date Required:</i> 11/30/2009 Support Hot Commissioning (which must be completed in 12/2007) and subsequent operation leading to Commercial Operation (which must be started by 12/2009).
Baseline Technology Information	
31	<i>Baseline Technology/Process:</i>
32	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with

	the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion.
33	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
34	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
35	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Reid Peterson, River Protection Project – Waste Treatment Plant, Research and Technology – Pretreatment Technology, P/509-371-5128, F/509-371-5163, email: rpeterso@bechtel.com
36	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo Rudy Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie M Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E J Cruz@rl.gov
37	<i>Other Contacts</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Sulfate Mitigation for Hanford Tank Low Activity Waste (LAW) Vitrification
2 *	<i>Need Code:</i> RL-WT101
3 *	<i>Need Summary:</i> Sulfate, which is a significant component in the supernate fractions of many tank wastes at Hanford, poses serious economic impacts and risks for the LAW vitrification process. Sulfate tends to phase separate in the melter forming a corrosive molten sulfate salt layer on top of the glass melt that will damage the melter and negatively impact glass quality if allowed to accumulate. Improved glass and feed formulation for sulfate incorporation are required.
4 *	<i>Origination Date:</i> FY 2001 (October 18, 2001)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: RL-TW06
9	<i>National Priority:</i> <div style="margin-left: 20px;"> ☐ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. ☒ 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success. </div>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> Hanford tank wastes will be retrieved and delivered to the RPP-WTP where it will be separated during pretreatment into high level waste (HLW) and low activity waste (LAW) fractions, both of which will be immobilized by vitrification for disposal as glass in canisters.
12	<p><i>Need/Problem Description:</i> Sulfate mitigation became a particularly important LAW vitrification issue for the RPP-WTP following a conclusion in January 2000 that it would not be practical to remove sulfate from LAW during pretreatment. An estimated 20% additional amount of ILAW glass is expected to be produced from sequentially processing all 177 tanks at the Hanford site. Blending of LAW feeds solutions could reduce the estimated increase in ILAW glass production.</p> <p>Sulfate is only sparingly soluble in glass melts and tends to separate forming a corrosive molten sulfate salt layer on top of the glass melt in the melter that will damage the melter if allowed to accumulate. The primary sulfate mitigation approach will be to operate the RPP-WTP so as to prevent the formation of phase separated sulfate salts in the melter. Preliminary testing has indicated maintaining the glass $\text{Na}_2\text{O} \cdot \text{SO}_3$ concentration product less than 5 wt% as a constraint for preventing sulfate salt separation. However, this empirical constraint can be affected by other composition variables and also depends on factors such as melt mixing and processing rate. For LAW derived from the higher sulfate content tanks, conservative processing constraints for sulfate will require substantial reductions in waste loading, increasing the quantity and cost of LAW glass to be produced and disposed of.</p> <p>It is expected that sulfate, along with halide salts also contained in the LAW, will result in decreased melter life due to enhanced corrosion of critical materials, especially if a sulfate salt</p>

	<p>layer accumulates in the melter. Molten sulfate salts are electrically more conductive and lower viscosity than the glass melt creating a risk for electrical shorting. The composition of potential separated salt phases is also critical, in that low melting temperature salt mixtures may form allowing deep penetration of molten salts into the refractory package of the melter increasing the risk of electrical shorting. There is also concern that feeding slurry or water onto a molten sulfate layer in the melter could cause over pressurization or a steam explosion in the melter. However, the actual risks and impacts on melter life associated with sulfate in LAW are not well characterized.</p> <p>Work done in prior waste vitrification programs to address sulfate issues have focused mainly on glass and feed formulation to optimize sulfate incorporation by the glass. A broader approach to sulfate control and mitigation is embodied in the RPP-WTP Research and Technology Program. However, the resources currently available for this work are not adequate to cover the scope of needs. Further mitigation methods development is needed to allow process optimization and provide for risk reduction. Details for specific recommended development areas follow.</p> <p><i>Glass and Feed Formulation:</i> Glass formulations must meet both product specification and process ability requirements. Reduced waste loading glass formulations for sulfate that meet the “Waste Form Testing” specifications and the preliminary empirical glass $\text{Na}_2\text{O} * \text{SO}_3 < 5 \text{ wt}\%$ constraint have been developed substituting other fluxing oxide glass former components for Na_2O. However, the composition and properties of sulfate phases that are formed when the sulfate incorporation thresholds (less than the glass solubility limits depending on melter dynamic factors) of these glasses are exceeded need to be considered. Mixed sulfate salts may be formed that are more corrosive than Na_2SO_4 and have lower melting temperatures, allowing deep penetration of the salts through joints and cracks in the melter refractory package creating electrical shorting and enhanced corrosion risks that may lead to melter failure. Sulfate salts potentially formed with candidate glass and feed formulations need to be characterized for composition, melting temperature range, electrical conductivity and corrosivity. Sulfate incorporation is also sensitive to feed conditioning additives used to control glass redox ($\text{Fe}^{+2}/\text{Fe}^{+3}$ ratio). Excessive feed reductant additions can lead to sulfide formation that can also damage the melter. There is a need to optimize the glass and feed formulation to allow for increased sulfur incorporation without unacceptable effects on process ability or product quality.</p> <p><i>Materials and Melter Design:</i> The baseline RPP-WTP LAW melter uses an active melt agitation system that aids sulfate incorporation into the glass. These agitation devices, and other refractory metal components such as thermowells, level detectors and airlift lances that enter the glass melt from above, have shown a tendency for corrosive failure primarily near the melt surface and require frequent replacement to prevent failure in the melter. The effects of sulfate salts on these components have not yet been well characterized. Possibly more important, the effects of sulfate phases that may be formed on non-replaceable melter materials such as refractories and critical metal components are not well understood. Some design modifications may also be needed for sulfate detection if a viable detection system is developed, or for a mechanical method for sulfate layer removal should process approaches for removal prove unsuccessful.</p> <p>There is first a need to determine the tolerance of melter materials and components to sulfate salt exposure, which will likely depend on salt composition and properties yet to be determined. The best materials need to be identified and designs for critical components developed to increase their service life.</p>
13	<p><i>Functional Performance Requirements:</i></p> <p>Glass and Feed Formulation</p> <ul style="list-style-type: none"> • Meet ILAW product specifications.

	<ul style="list-style-type: none"> • Melt viscosity at 1150°C of 20-100 poise. • Glass melt electrical conductivity compatible with power supply capabilities. • Glass liquidus temperature <950°C. • Not be corrosive to melter components. • Will not form stable salt phases with melting temperatures below ~600°C. <p>Materials and Melter Design</p> <ul style="list-style-type: none"> • Consumable melter components should be designed to require minimal maintenance considering the potential for sulfate exposure and have a minimum replacement life before failure of two months. • Refractory package design needs to consider properties (particularly melting temperatures, electrical conductivity and corrosivity) of salt layer phases potentially formed in the melter.
14	<i>Definition of Solution:</i> The sulfate in LAW mitigation needs will be satisfied when: 1) reliable/cost effective detection methods have been developed that detect sulfate salt layers in the melter, 2) reliable/cost effective sulfate layer removal techniques have been developed, 3) glass/feed formulations have been optimized for waste loading, product properties and melter processability, and 4) materials and melter component designs have been developed that significantly improve the life of replaceable and non-replaceable melter components in the presence of a sulfate layer.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<i>Potential Benefits:</i> The major benefit of these facilities is to ensure that the WTP starts up and operates according to plan and schedule: processing the various wastes in the quantities expected. The primary benefit of solving these needs is cost savings. The presence of sulfate in the LAW feed to the melter is expected to increase the operating time and amount of LAW glass produced from minimum order quantity feeds by ~25%. Other benefits include reduced worker dose commensurate with the reduced operating time and reduced frequency of melter maintenance and replacement.
17	<i>Potential Cost Savings:</i>
18	<i>Potential Cost Savings Narrative:</i>
19	<i>Technical Basis:</i> Current LAW glass formulations on the RPP-WTP Project are limited by the Na ₂ O * SO ₃ concentration product less than 5 wt% constraint. This preliminary empirical constraint was developed by recent glass formulation and melter testing programs, and reduces potential waste loadings of some waste types (e.g., AZ-102 and AN-102) by more than 60%. An estimated 20% additional amount of ILAW glass is expected to be produced from sequentially processing all 177 tanks at the Hanford site. Blending of LAW feeds solutions could reduce the estimated increase in ILAW glass production.
20	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
21	<i>Environment, Safety, and Health Basis:</i> A reduction in the amount ILAW product that needs to be processed, and less frequent melter maintenance and replacement campaigns, will result in less worker dose.
22	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste.

	By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
23	<p><i>Milestones:</i></p> <p>November 15, 1999 tri-party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase I Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Retrieve all SSTs 2018 • Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
24	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
25	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
26	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
27	<i>Contaminated Media:</i> The LAW melter will be contaminated internally from the LAW glass and deposits from volatilized LAW constituents. The localized shielding enclosure of the LAW melter allows them to be contact maintained. The shielding enclosure will be sealed and externally decontaminated for spent melter disposal. Tank waste consisting of supernate (liquid), salt cake, and sludge.
28	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
29 *	<i>Earliest Date Required:</i> 9/2002
30 *	<i>Latest Date Required:</i> 9/2005
Baseline Technology Information	
31	<p><i>Baseline Technology/Process:</i> The current baseline technology for LAW sulfate mitigation is a conservative process approach that limits the waste loadings in LAW glasses such that the product of the wt% of Na₂O times the wt% SO₃ in the glass does not exceed 5. Glasses meeting this constraint are generally processable without formation of a sulfate salt layer. Baseline technologies have not yet been selected for melter sulfate salt layer detection or removal. The baseline LAW melter is the GTS Duratek locally shielded melter (LSM). No modifications have yet been made to the LSM design for LAW sulfate mitigation</p> <p>Technology Insertion Point(s): N/A</p>
32	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion..
33	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as

	ensuring operational success not to add additional cost to the system.
34	<i>Completion Date Using Baseline:</i>
	Points of Contact (POC)
35	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Steve Barnes, River Protection Project – Waste Treatment Plant, Research and Technology – Vitrification Technology, P/509-371-5127, F/509-371-5163, email: smbarnes@bechtel.com
36	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo Rudy Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie M Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E J Cruz@rl.gov
37 *	<i>Other Contacts:</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Process Flowsheet Model
2 *	<i>Need Code:</i> RL-WT118
3 *	<i>Need Summary:</i> An integrated simulation tool is needed to assist consideration of glass durability as a function of changes in composition (due to waste feed and waste processing variability). The focus of the effort is to develop a master library of models of key unit operations, e.g., ion exchange, filtration, etc., that can be used to evaluate baseline operations impact on glass durability. The model library would be designed for use in Aspen Custom Modeler.
4 *	<i>Origination Date:</i> FY2002 (October 18, 2001)
5 *	<i>Need Type:</i> Technology
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: ORP-TW06LT
9 *	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> X </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> DOE-EM has carried out a very extensive research and technology program relative to HLW processing needs associated with the Hanford Site, Savannah River Site, Idaho National Engineering and Environmental Laboratory Site, and West Valley Demonstration Project Site. Areas of concentration have included solid-liquid separations, radionuclide separations, separations of other problem constituents (e.g., aluminum and chromium), and in HLW glass production. The data from this complex-wide research and technology program needs to be incorporated into a master library of models of key unit operations to assist in considerations of glass durability (i.e., performance assessment) as a function of changes in composition (due to waste feed and waste processing variability). The model library would be designed for use in Aspen Custom Modeler. The model library and associated data would benefit all HLW sites.
13	<i>Functional Performance Requirements:</i>

	<i>Schedule Requirements:</i>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tank Focus Area
16	<i>Potential Benefits:</i> : The major benefit is to provide a system planning tool and to perform performance assessment activities on flowsheet.
17 *	<i>Potential Cost Savings:</i>
18 *	<i>Potential Cost Savings Narrative:</i>
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
	<i>Technical Basis:</i>
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22 *	<p><i>Milestones:</i> November 15, 1999 tri-party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Retrieve all SSTs 2018 • Close SSTs 2024 • Immobilize remaining tank waste 2028 • Close all tanks 2032
23 *	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
24	<i>TSD System:</i> Input not required.
25	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
26	<i>Contaminated Media:</i> Tank waste consisting of supernate, (liquid), salt cake, and sludge.

27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is in support of WTP permitting.
29 *	<i>Latest Date Required:</i> 11/2009 Support Hot Commissioning (which must be completed in 12/2007) and subsequent operation leading to Commercial Operation (which must be started by 12/2009).
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> Technology Insertion Point(s): (as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Steve Barnes, River Protection Project – Waste Treatment Plant, Research and Technology – Vitrification Technology, P/509-371-5127, F/509-371-5163, email: smbarnes@bechtel.com Reid Peterson, River Protection Project – Waste Treatment Plant, Research and Technology – Pretreatment Technology, P/509-371-5128, F/509-371-5163, email: rpeterso@bechtel.com
35	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo Rudy Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie M Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E_J Cruz@rl.gov
36 *	<i>Other Contacts:</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Melter Disassembly and Disposal
2 *	<i>Need Code:</i> RL-WT119
3 *	<i>Need Summary:</i> Methods to decommission a High Level Waste (HLW) melter at end of life and to change out individual melter system components during hot operations are needed.
4 *	<i>Origination Date:</i> FY2002 (October 18, 2001)
5 *	<i>Need Type:</i> Technology
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Waste Treatment and Immobilization Plant PBS No: RL-TW06
9 *	<i>National Priority:</i> <u> </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> X </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<p><i>Need/Problem Description:</i> WTP currently does not have the capability to decommission, size reduce, decontaminate, classify and dispose of failed, highly contaminated processing equipment. This includes failed high level waste glass melters, process vessels and process equipment. A single failed glass melter, for example, could contain as much HLW glass as five canisters. It will contain additional contamination in the form of unmelted waste solids and as volatile cesium. It is unacceptable to place this "waste form" in relatively uncontrolled long term storage and to continue to add more of the same and other equipment.</p> <p>While failed HLW Glass melters are prime examples to demonstrate this need, it also applies to other equipment such as failed jumpers, off-gas system components, process tanks, equipment, pumps and others.</p> <p>The radioactive properties of the feed stream as well as the glass product stream will require component change out / melter decommissioning to be done remotely. Life expectancies for melter system components (i.e. feed system, refractory, electrodes, thermowells offgas system) need to be established through corrosion and erosion testing. A melter system design needs to be developed that incorporates remote melter component decontamination and change out</p>

	capabilities. An evaluation of available radioactive melter system decontamination technology with respect to component change out and decommissioning should be completed and applied where possible.
13	<i>Functional Performance Requirements:</i> Equipment must ultimately be capable of remote handling, dismantling and size reduction of equipment occupying WTP melt cell. The facility must be capable of dismantling, cutting, size reduction, decontamination, and classification of various materials including: metal alloys, plastic and elastomeric materials, electrical motors/equipment, refractory and ceramic materials, glass blocks, other miscellaneous materials. Facility equipment must be remotely replaceable and must be capable of operation in a high radiation field.
	<i>Schedule Requirements:</i>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tank Focus Area
16	<i>Potential Benefits:</i> : The major benefit is to ensure that the WTP starts up and operates according to plan and schedule: processing the various wastes in the quantities expected.
17 *	<i>Potential Cost Savings:</i> \$
18 *	<i>Potential Cost Savings Narrative:</i> The ability to cost-effectively perform remote change-out of components and decommissioning of those parts will reduce secondary waste generation and down-time, providing significant life-cycle cost savings for operating the vitrification facility.
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
	<i>Technical Basis:</i> To date, no radioactively contaminated full scale joule heated melters have been decommissioned in the DOE system. This technology must be developed. High Level Waste (HAW) melter operation and maintenance experience and lessons learned from operating sites may be applicable.
20	<i>Environment, Safety, and Health Basis:</i> Although adequate for short term storage with routine surveillance, long term storage of contaminated high level waste equipment poses a high risk of spread of contamination to the environment.
21	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22 *	<i>Milestones:</i> November 15, 1999 tri-party agreement on principal regulatory commitments: <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and

	25% of the tank waste by activity) 12/20 18
	Other selected TPA milestones are: <ul style="list-style-type: none"> ● Retrieve all SSTs 2018 ● Close SSTs 2024 ● Immobilize remaining tank waste 2028 ● Close all tanks 2032
23 *	<i>Material Streams:</i> Hanford High-Level Defense Waste. The River Protection Project (formerly known as the Tank Waste Remediation System) involves PBSs RL TW-01 through TW-09. The technical, work scope definition, and intersite dependency risks for Phase 1 Waste Treatment and Immobilization is respectively, 3,3,3 on a scale of 1 to 5 where "5" represents high programmatic risk. This stream is on the critical closure path for Hanford Site cleanup.
24	<i>TSD System:</i> Input not required.
25	<i>Major Contaminants:</i> Fission products, actinides, and nitrate.
27	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge.
28	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
29 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is in support of WTP permitting.
30 *	<i>Latest Date Required:</i> 10/2007 To support Phase 2 operations a FY 2008 completion date will be required.
Baseline Technology Information	
30	<i>Baseline Technology(ies)/Process:</i> The current baseline approach to dealing with this equipment is long term storage in the canyon facilities. Technology Insertion Point(s): (as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> Paul Rutland, River Protection Project – Waste Treatment Plant, Process Technology Flowsheet, P/509-371-5213; F/509-371-5163; email: plrutlan@bechtel.com Steve Barnes, River Protection Project – Waste Treatment Plant, Research and Technology – Vitrification Technology, P/509-371-5127, F/509-371-5163, email: smbarnes@bechtel.com
35	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE Office of River Protection Project Requirements Division, 509-373-7771, F/509-373-0628, email: Rodolfo_Rudy_Carreon@rl.gov B.M. (Billie) Mauss, DOE Office of River Protection Program Office, 509-373-9876, F/509-372-2781, email: Billie_M_Mauss@rl.gov E.J. (Joe) Cruz, DOE Office of River Protection Project Requirements Division, 509-372-2606, F/509-373-1313, email: E_J_Cruz@rl.gov
36 *	<i>Other Contacts:</i>

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

BALANCE OF MISSION

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Extension of Glass Properties Model to LAW and Phase II HLW Glass Composition Ranges
2 *	<i>Need Code:</i> RL-WT084
3 *	<i>Need Summary:</i> The glass properties model, developed by PNNL to describe the liquidus temperature, viscosity, and durability of glasses as a function of their compositions, should be extended to include projected LAW compositions and lower silica compositions recently projected for HLW.
4 *	<i>Origination Date:</i> FY 2000 (2/25/00)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Office of River Protection - Treat Waste Balance of Mission <i>PBS No.:</i> ORP-TW07
9 *	<i>National Priority:</i> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. X 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> Double Shell Tank (DST) and Waste Feed Delivery project maintains, operates and upgrades the DST System for continued safe storage and receipt of radioactive waste. Activities include transferring waste to waste treatment facilities, maintaining and evaluating operating and surveillance systems necessary for compliance with regulatory and AA/AB requirements, identifying if systems are reliable for this mission, transferring waste within the DSTs to manage the limited available space; characterizing waste to understand its properties, and developing flow sheets for waste treatment.
12	<i>Need/Problem Description:</i> The "Glass Properties Models" (GPM) were developed by PNNL to model certain properties of waste glasses as functions of their compositions. These models and knowledge of the glass properties, such as liquidus temperature, viscosity, and durability, may be used to determine the amounts of waste that can be practically incorporated into the glass and to provide estimates of the volume of the final immobilized waste form. These estimates are critical to successful processing of Hanford's high-level wastes into acceptable vitrified waste forms, since they are used to predict the waste feed rates and total amounts of feed required to meet the terms of the vitrification contract. Currently, the GPM supports predictions for glass compositions ranging consistent with previous flowsheet assumptions for the Hanford Waste Vitrification Plant (HWVP). However, recent developments in the HLW vitrification program and addition of the LAW vitrification have changed the composition region in which Hanford will produce glass. Examples of the differences in composition include a reduction of SiO ₂ and increase in SrO and MnO. Comparisons have shown that current GPM-based predictions of glass properties in some

	of this new composition space are inaccurate. This difference could potentially lead to large differences prediction of glass volumes, feed requirements, and melter sizing. Lack of an accurate model also jeopardizes the ability of the Waste Feed Delivery Project to accurately predict the amounts of waste that are required to meet production goals. The effect of these proposed glass formulation changes on the GPM predictions is not known. GPM must be updated to cover the new expected composition regions for both HLW and LAW glasses for those properties that may limit the loading of waste in glass, including troublesome component solubilities, liquidus temperature, viscosity, and product consistency test. Additional data must be obtained to improve the accuracy of these GPMs and to validate them within the expected glass composition regions. Expanded glass models may also be applicable to increasing waste oxide loading at the Defense Waste Processing Facility (Savannah River) and at the Idaho National Environmental and Engineering Laboratory (Idaho Falls).
13	<p><i>Functional Performance Requirements:</i> Models capable of predicating key properties of Hanford LAW and HLW glasses will be developed. Those properties found to be most responsible for waste loading limitation in Hanford LAW and HLW glasses will be the primary focus, including: liquidus temperature and solubility's of troublesome components. The composition regions over which these models are to be developed will include those expected from vitrification of all waste from Hanford underground storage tanks. Differences between the composition regions covered by existing data, those expected from Hanford LAW and HLW glasses will be identified, and test matrices will be developed to cover these composition regions. Priority will be given to those properties and compositions applicable to most of the Hanford waste.</p> <p>When completed, the models will be capable of estimating waste loading as a function of waste composition and will help in glass formulation development and complete flowsheet optimization (including retrieval, pretreatment, and blending).</p> <p><i>Schedule Requirements:</i> 0-3 yr. The near-term need for this information is to improve the reliability of the Waste Treatment Plant design and plans for delivery of waste feed to the Waste Treatment Plant. Needs for this type of data will remain well into the life of the project (>20 yr.) as program requirements change and opportunities for cost savings arise.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> Removing uncertainty of glass volume prediction will improve the ability to deliver wastes efficiently and on time. Development of glasses with higher waste loadings would produce large cost savings.
17 *	<i>Potential Cost Savings:</i> \$250,000,000
18 *	<p><i>Potential Cost Savings Narrative:</i></p> <p>Reduced conservatism in HLW/ILAW performance assessment and disposal system design.</p>
	<i>Technical Basis:</i> Although the GPM can be extrapolated to cover the low-silica glasses, there is no data in the GPM in that range. Current indications are that the GPM correlations are highly curved in this region, leading to substantial errors.
19	<i>Cultural/Stakeholder Basis:</i> Long-term disposal of the high-level wastes stored in Hanford's underground tanks is a national priority. The DOE has a legal agreement (the Tri-Party Agreement) with the Environmental Protection Agency and the State of Washington Department of Ecology to dispose of the waste according to a stated schedule. Native American tribal interests and a number of public interest groups monitor adherence to this agreement. Program delays due to inability to retrieve and deliver sufficient waste feed to the WTP may result in violations of the Tri-Party Agreement.

20	<i>Environment, Safety, and Health Basis:</i> Program delays provide more time for the waste storage tanks to fail. It is important to maintain programmatic schedule to avoid increased risks of soil contamination from tank leakage.
21	<i>Regulatory Drivers:</i> Tri-Party Agreement (TPA)
22	* <i>Milestones:</i> Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," 9/30/2000 and annually thereafter.
23	* <i>Material Streams:</i> ID-3857 HLW to Treatment and LAW
24	* <i>TSD System:</i> Hanford 200 Area underground storage tanks ("tank farms") DSTs and SSTs
25	<i>Major Contaminants:</i> Fission products, actinides, nitrate
26	<i>Contaminated Media:</i> N/A. This project addresses wastes in engineered containment.
27	<i>Volume/Size of Contaminated Media:</i> 204,400 m ³ . See R. A. Kirkbride, "Tank Farm Contractor Operation and Utilization Plan," HNF-SD-WM-SP-012, Rev. 2, p. "Summary-3," (CH2M HILL Hanford Group, Inc., Richland, WA, April 19, 2000). For details, see, e.g., B. M. Hanlon, "Waste Tank Summary Report for Month Ending June 30, 2000," HNF-EP-0182-147, (CH2M HILL Hanford Group, Inc., Richland, WA, August 2000).
28	* <i>Earliest Date Required:</i> 03/20/2000
29	<i>Latest Date Required:</i> 2020
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> The GPM provides the baseline technology for prediction of glass waste volume. <i>Technology Insertion Point(s):</i> N/A
31	<i>Life-Cycle Cost Using Baseline:</i> Costs are included in Activity 150.B22, "Maintain the Operations & Utilization Plan." Life Cycle Costs related to glass volume production are best represented by the differential cost related to reduced number of waste packages produced. For example, costs of equipment, operations, maintenance and infrastructure upgrades over time, will be incurred whether the facilities produce one canister of glass or 1,000. Using this premise, a 20% reduction in number of HLW canisters can result in savings of about \$1-2 Billion in repository fees on production costs of \$4-8 Billion.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> Unknown
33	<i>Completion Date Using Baseline:</i> Maintenance of the Operations & Utilization Plant continues through the life of the project. The RPP is scheduled to complete in year 2030.
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> R.(Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo Rudy Carreon@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie M Mauss@rl.gov
36	* <i>Other Contacts:</i> S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen A Wiegman@rl.gov M.E. (Michael) Johnson, CH2M HILL Hanford Group, Inc., 509-372-3628, F/509-376-1788, Michael E Johnson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Erosion Testing
2 *	<i>Need Code:</i> RL-WT098
3 *	<p><i>Need Summary:</i> The vitrification plant and waste treatment plant will move large volumes of liquid waste during a projected 40-year work life. Many of the liquid wastes will have suspended particles. Not only particles from waste but also glass formers that are recycled inside the plant will be moved. Very little is known about the abrasion of these particles on the various metal parts (pump impellers, piping, protruding instrument wells, etc.).</p> <p>This fiscal year there is to be an erosion study at Savannah River Technical Center to study the effects on erosion on the ultrafiltration step in the waste treatment plant. This test has a planned 2000-hour (~83 day) duration. This test is to demonstrate the erosion resistance in the ultrafilter and LAW evaporator systems that have very high velocities (up to 15 ft/sec) and will be conducted for a duration of ~90-days. Some previous testing has been conducted to measure the Miller Number (a measure of abrasiveness of a slurry) for some simulated wastes. There have been limited measurements of Miller number in the past on actual waste and additional measurements will be needed.</p> <p>The waste abrasiveness as measured by the Miller and SAR numbers needs to be correlated with simulants to assure the simulants are adequate. Other parts of the plant will transfer waste at slower velocities (~ 7 ft/sec). Extrapolating erosion rates to these lower velocities accurately needs to be considered. These tests need to be correlated to actual plant experience at West Valley and at Savannah River.</p>
4 *	<i>Origination Date:</i> FY 2001 (November 8, 2000)
5 *	<i>Need Type:</i> Technology
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Office of River Protection - Treat Waste Balance of Mission <i>PBS No:</i> ORP-TW07
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>___ 2. <u>Medium</u> - 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).</p> <p><u>X</u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements,

	pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> Current testing plans for approximately 2000 hours in a flow loop. The erosion information will then be used to extrapolate to a plant that has at least a 40-year design life. An erosion rate that is too small to measure in a 200-hour test may still be too large for the plant. A longer-term erosion test is needed to confirm the initial erosion rate.
13	<i>Functional Performance Requirements:</i>
14	<i>Definition of Solution:</i> Acceptable solutions will be achieved when calculations and testing of waste simulants demonstrates the expected piping and equipment erosion rates for the projected 40-year design life for the RPP-WTP.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<i>Potential Benefits:</i> The major benefit of these facilities is to ensure that the WTP starts up and operates according to plan and schedule: processing the various wastes in the quantities expected
17 *	<i>Potential Cost Savings:</i> Hundreds of millions of dollars.
18 *	<i>Potential Cost Savings Narrative:</i> With the WTP annual operating cost expected to be in the hundred's of millions of dollars, minimizing plant start up or down time will be a key potential savings, easily measured in the tens of millions of dollars. Additionally, plant process equipment and piping will cost hundreds of millions of dollars to replace if the design basis is incorrect and equipment fails prematurely due to erosion.
	<i>Technical Basis:</i> While the design life of the initial plant is 40 years, only relatively short term testing is planned. There is uncertainty in extrapolating these tests to a 40-year WTP design life. Longer-term erosion testing is needed to confirm the initial erosion rate.
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program, a capability to test the processes and equipment planned with actual wastes.
20	<i>Environment, Safety, and Health Basis:</i>
21	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22 *	<p><i>Milestones:</i></p> <p>Tri-Party agreement on principal regulatory commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Commercial Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>• Other selected TPA milestones are:</p>

	<ul style="list-style-type: none"> ● Immobilize remaining tank waste 2028 ● Close all tanks 2032
23 *	<i>Material Streams:</i> ID-3857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
25	<i>Major Contaminants:</i> Fission products, actinides, nitrate
26	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is immediately to support the TPA milestone for Part B Permit Application for Phase I Treatment Complex.
29 *	<i>Latest Date Required:</i> Support the procurement of major plant equipment and piping, which is anticipated to be in fiscal year 2003.
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Technology Insertion Point(s): (as applicable)
31	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
33	<i>Completion Date Using Baseline:</i> Plant operations will be completed between 2028 and 2040.
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> R.(Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo Rudy Carreon@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie M Mauss@rl.gov
36 *	<i>Other Contacts:</i> S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen A Wiegman@rl.gov M.E. (Michael) Johnson, CH2M HILL Hanford Group, Inc., 509-372-3628, F/509-376-1788, Michael E Johnson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Enhanced HLW/LAW Melter Operation
2 *	<i>Need Code:</i> RL-WT100
3 *	<i>Need Summary:</i> Operational issues with the HLW and LAW melters are opportunities for risk reduction and cost savings for the RPP. Many of them relate to the use of bubblers in the melters and the required frequency of replacement. Frequent bubbler replacement will result in added downtime and additional contamination to the melter cells. This facility contamination, if extreme, could severely impact the ability to do equipment (e.g., crane and manipulator) maintenance. Technical needs related to melter operation are separated into the three general areas described below as follows: operational data needs from West Valley Demonstration Project, processing rate, advanced corrosion-resistant materials, and noble metals accumulation mitigation.
4 *	<i>Origination Date:</i> FY 2001 (November 8, 2000)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Office of River Protection - Treat Waste Balance of Mission <i>PBS No:</i> ORP-TW07
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> Operational Data Needs from West Valley Demonstration Project: <u>Long-term consequences of cell contamination due to replacement of spent melter components -</u> Currently, the basis for the RPP-WTP HLW melter design is to feed the melter without bubbling agitation. However, preliminary pilot melter testing suggests that attainment of the design-processing rate of 1.5 MT/day is not likely without bubbling. Use of bubblers to achieve higher throughput would currently involve the change out of many more components over the life of the facility, perhaps by a factor of three.

It is known that the removal of melter components contaminates the cell but the long-term impact is not known. Early and extensive cell contamination could have major adverse impact on the facility's operational cost and on occupational exposures during its 40 year operating life. Descriptions of the AVH operations in the UK and in France indicated that a cell crane had become contaminated to a level of 10,000 REM. When crane maintenance was required, about six months of crane decontamination was required before it could be repaired. This caused very high total personnel doses and adversely impacted the production facility's availability. This level of contamination was reached apparently after about 10 to 15 years of operation.

It is unclear whether this high contamination is due to calciner maintenance or the relatively high change out of the Inconel melter components or some other factor. However, an evaluation of the extent of contamination of a similar facility (West Valley Demonstration Project) to that of the RPP-WTP would provide directly applicable data to help determine if this is a concern for a long term RPP operating facility. Should unforeseen, undemonstrated and bulky remote change-out equipment be designed and used? Should costly R&D be completed to extend the longevity of equipment to minimize component change out or is this really a non-issue for liquid fed ceramic melter?

Pressure Fluctuations in the Melter and Submerged Bed Scrubber - The SBS is the reference first scrubber in the LAW and HLW vitrification off gas systems. It is known that the nature of the original design includes natural oscillation of from ± 1 to 5 inches water column. To make operations more stable with less likelihood of contaminating the cell, these pressure fluctuations were reduced with a design change and tested on a one-third scale SBS. The design change did reduce the pressure fluctuations. However, plugging of the SBS lines has occurred which may require going back to the original design. The characteristics of a unit nearer full scale are desired to verify scale up and bottom distributor plate design. West Valley has an operating SBS with a known design. Characterization of the melter, SBS, SBS liquid level and SBS specific gravity pressure fluctuations would advance the understanding of the systems operations without significant additional costs. However, the West Valley instrumentation is not sufficiently responsive for making these measurements.

For advancing and improving the baseline SBS design for RPP, it is requested that a more sensitive pressure measurement system with congruent data logging be installed in parallel to West Valley's operating sensors to gather this data.

Noble Metals Accumulation Measurement - Noble metals accumulation appears to be the life limiting issue for the RPP-WTP HLW melter. The current design is based upon several assumptions about the mass fraction that accumulates and the volume concentration in the settled sludge. West Valley has completed nearly two years of operations with a noble metals concentration comparable to the RPP-WTP flow sheet. A sample of this sludge has been taken as part of the TFA effort. However, an estimate of the volume of sludge has only been speculated based upon an electrical conduction assumption. To better estimate the actual volume accumulated, measurements of the depth and distribution of the sludge in the actual melter is needed. Probing for the depth of the sludge layer from the different lid nozzles would better define the actual volume of sludge that has accumulated. This could be achieved during replacement of spent lid assemblies in the feed nozzle, thermowells, glass level, etc (nozzles A, B, BB, D, E, FF, R1 and R2).

To replicate the information already available in the West Valley melter it would take over two years and ~ \$100 million worth of operations and the cost of noble metals. Since this information drives the WTP-RPP design, the estimated volume based upon an actual operated melter could clarify the scope of the issue that needs to be address at RPP-WTP and its 40 years of operations.

Processing Rate: As discussed above, preliminary pilot melter testing suggests that attainment of the RPP-WTP HLW melter design throughput of 0.4 MT/m²/day (1.5 MT/day) is not likely without bubblers and bubbling may be required. Use of bubblers to achieve higher throughput would currently involve the change out of many more components over the life of the facility and result in greater contamination to the facility. There is a need to thoroughly evaluate, and develop if possible, alternative approaches to increasing processing rates to achieve the HLW design basis throughput and potentially exceed the design basis for enhanced throughput scenarios. A number of technical aspects of the melter operation are important to increasing melting rates, specifically monitoring systems, feed staging and blending, convective heat transfer and temperature of the melt, and cold cap chemistry. Potential areas to be investigated include feed chemistry (glass formulation, pH adjustment, redox adjustment), glass formers (glass former type, frit versus raw chemicals), water content and heat transfer to the cold cap. The RPP-WTP project is evaluating some of these variables, but does not have sufficient resources to thoroughly investigate the issue.

Advanced, Corrosion-Resistant Materials: Advanced materials of construction or coatings have the potential to significantly improve melter reliability and lifetime. Certain melter components are highly susceptible to corrosion including bubbler tubes, thermowells, electrodes, offgas components, and refractory. Certain of these components are considered to be consumables (e.g., bubbler tubes, thermowells, off-gas components) and will be replaced periodically in the Hanford HLW/LAW melters. The required frequency of replacement will impact time operating efficiencies and overall contamination of the melter cells. Additionally, gross contamination of the melter cells, both HLW and LAW, has the potential of compromising the operating philosophies. That is, excessive contamination of the LAW melter cell will compromise the contact handled maintenance philosophy, and gross contamination of the HLW melter cell will result in extended operating down times for decontamination/maintenance of the crane. Advanced materials of construction or coatings that extend the life of the melter components (particularly consumables) will reduce risk and save operating costs.

The melter components are exposed to physical and chemical conditions in the molten glass and in the vapor space, and will need to be resistant to corrosion in both environments. Vapor space conditions of interest include temperatures between 400°C and 1200°C and the presence of O₂, NaCl, Na₂SO₄, and acid gases. Molten glass conditions include a nominal temperature of 1150°C, glass compositions consistent with HLW and LAW waste, and a potential Na₂SO₄ layer.

The RPP-WTP Project is currently funding some work in this area, but it is insufficient to reasonably explore promising materials. Envisioned activities in a materials development program for this application include: definition of relevant chemical/physical environment; selection/development of candidate materials and coatings; coupon testing and examinations using SEM, EDS, XRF, and weight loss; understanding of corrosion/erosion mechanisms; and pilot-scale testing.

Noble Metals Accumulation Mitigation: Noble metals are present in Hanford HLW in concentrations that are high enough to form insoluble particles in the melter. These particles, primarily RuO₂, may settle and accumulate in a sludge at the melter bottom. In Joule-heated ceramic melters the noble metal sludge was found to significantly alter the electrical current density distribution within the melter or even form a short circuit path between electrodes. In addition, this sludge, often containing other crystalline compounds such as spinel, may block the melter pouring assembly. A strategy must be developed to avoid the possibly catastrophic effects of noble metal accumulation in the Hanford HLW glass melters. Aspects of this strategy are likely to include: 1) determination of the acceptable concentrations of noble metals in the melter

	to avoid accumulation, 2) development of tools for detection of sludge formation and growth, and 3) identification of methods to remove the sludge layer or mitigate its adverse effects. It is expected that primary emphasis will be placed on the determination of acceptable noble metal concentrations as functions of key parameters using crucible tests, modeling, and limited melter demonstrations. Past studies indicate that the variables that significantly impact sludge formation include glass composition, noble metal concentration, and processing conditions.
13	<p><i>Functional Performance Requirements:</i></p> <p>Operational Data from West Valley Demonstration Project: Determine, through survey measurements, the cell contamination of West Valley's operating cell and cell crane. During the cell radiation survey, complete a vertical scan of the melter's lid refractory to estimate the depth to which the cesium salts penetrate the refractory. This information is needed for appropriate design of the LAW lid and shielding. Characterize the vertical radioactivity of spent melter components including vertically along the refractory plug. From the operating and maintenance logs, identify the number and frequency of melter component change outs and other activities that could have led to the existing cell contamination level.</p> <p>Processing Rate: Approaches for increasing processing rates need to achieve or exceed the design basis glass processing rate of 1.5 MT/day (0.4 MT/m²/day), and following thorough evaluation be shown to be preferable to the melt bubbling alternative.</p> <p>Advanced, Corrosion-Resistant Materials: Benchmark materials for consumable melter components and glass contact refractories are Inconel 690 and Monofrax K3, respectively. Candidate advanced materials and coatings must have corrosion-resistances that exceed the benchmark materials, and must have similar or appropriate physical properties that impact melter performance (e.g., thermal shock resistance, electrical conductivity).</p>
14	<p><i>Definition of Solution:</i></p> <p>Processing Rate: Methods are developed for increasing HLW processing rates without bubbling that on an overall cost/risk/schedule impact basis provide a preferable alternative to bubbling.</p> <p>Advanced, Corrosion-Resistant Materials: Advanced materials, coatings, or passivation schemes will need to be reliably fabricated and/or implemented and should improve the lifetime of melter components by approximately 50% or greater.</p>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area
16	<i>Potential Benefits:</i> Completion of this task provides a clearer basis for design criteria for melter, other cell and remote handling equipment. These criteria would then support the achievement of the full 40 years of design life and better limit personnel exposures.
17	<i>Potential Cost Savings:</i> \$50M to \$300M in operating costs
18	<i>Potential Cost Savings Narrative:</i> Collection of the WVDP data could save an estimated \$1M to \$5M for development, testing, design and construction of potentially unnecessary remote equipment and systems. Successful resolution of the issues stated above could avoid six months to three years delayed production over the operating life of the facility (\$50M to \$300M in additional operating costs).
	<i>Technical Basis:</i> Current operating vitrification facilities have not collected that data being requested from West Valley.
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure

	that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
20	<i>Environment, Safety, and Health Basis:</i> Reduced operating time and melter cell contamination will result in avoidance of 100 to 1,000 man-rem of exposure.
21	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22	<p><i>Milestones:</i></p> <p>Tri-Party Agreement commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Commercial Operation-Phase I Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Immobilize remaining tank waste 2028 • Close all tanks 2032
23	<i>Material Streams:</i> ID-3857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
25	<i>Major Contaminants:</i> Fission products, actinides, nitrate
26	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	<i>Earliest Date Required:</i> 11/2002 The earliest date required is to support the TPA milestone for Part B Permit Application for Phase I Treatment Complex.
29 *	<i>Latest Date Required:</i> 11/2009 Support Hot Commissioning (which must be completed in 12/2007) and subsequent operation leading to Commercial Operation (which must be started by 12/2009).
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i>
31	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as

	ensuring operational success not to add additional cost to the system.
33	<i>Completion Date Using Baseline:</i> Plant operations will be completed between 2028 and 2040
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo Rudy Carreon@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie M Mauss@rl.gov
36 *	<i>Other Contacts</i> S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen A Wiegman@rl.gov M.E. (Michael) Johnson, CH2M HILL Hanford Group, Inc., 509-372-3628, F/509-376-1788, Michael E Johnson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Pretreatment Approaches to Mitigate Sulfate Issues in LAW Immobilization
2 *	<i>Need Code:</i> RL-WT120
3 *	<i>Need Summary:</i> Sulfate, which is a significant component in the supernate fractions of many tank wastes at Hanford, poses serious economic impacts (creating more glass) and risks for the LAW vitrification process. Sulfate tends to phase separate in the melter forming a corrosive molten sulfate salt layer on top of the glass melt that will damage the melter if allowed to accumulate. Removing sulfate from the LAW before vitrifying can mitigate this problem, and new cost-effective separation technologies are needed.
4 *	<i>Origination Date:</i> FY 2002 (November 2001)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Office of River Protection - Treat Waste Balance of Mission <i>PBS No:</i> ORP-TW07
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> Hanford tank wastes will be retrieved and delivered to the RPP-WTP where it will be separated during pretreatment into high level waste (HLW) and low activity waste (LAW) fractions, both of which will be immobilized by vitrification for disposal as glass in canisters.
12	<i>Need/Problem Description:</i> Sulfate separation became a particularly important LAW vitrification issue for the RPP-WTP following a conclusion in January 2000 that the initially proposed ion exchange technology would not sufficiently remove sulfate from LAW liquids. This could result in an estimated 20% increase in the amount of ILAW glass produced from sequentially processing all 177 tanks at the Hanford site. Separating sulfate from highly alkaline salt solutions containing several molar concentrations of competing ions such as hydroxide, nitrate, nitrite, and carbonate is an unusual and difficult separation. The sulfate removed from the LAW stream as a secondary waste must also be suitable for disposal, and the separation technology should have a minimal impact on the vitrification of the treated LAW stream. Because sulfate is only sparingly soluble in LAW glass melts, it can form a molten sulfate salt layer on top of the glass melt if the solubility limit is exceeded. A molten sulfur layer in the LAW melter can lead to accelerated corrosion of the melter and unacceptable operating conditions (e.g.

	steam explosion or a sulfur waste form that does not meet the acceptance criteria). The problems associated with sulfate in the LAW feed could be mitigated through either pretreatment to remove sulfate, or through improving the vitrification technology such that more sulfate can be incorporated into the ILAW. The latter approach is discussed under a separate technology need (RL-WT101). This need statement addresses the mitigation strategy in which sulfate is separated from the LAW feed before vitrification.
13	<p><i>Functional Performance Requirements:</i></p> <ul style="list-style-type: none"> • Ability to separate sulfate from highly alkaline salt solutions containing several molar concentrations of competing ions such as hydroxide, nitrate, nitrite, and carbonate. • Sulfate-depleted LAW must yield a $\text{Na}_2\text{O} * \text{SO}_3$ concentration in the glass product of less than 5 wt%. This is the assumed constraint for preventing sulfate salt separation in the melter. • The separated sulfate must not be in a form that prevents disposal by an alternative disposal path.
14	<i>Definition of Solution:</i> The sulfate in LAW mitigation needs will be satisfied when a reliable and cost effective sulfate separation method has been developed and demonstrated on actual LAW feed.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> The major benefit of the sulfate removal technology is to reduce the overall life cycle cost of the RPP mission by reducing the volume of ILAW. The presence of sulfate in the LAW feed to the melter is expected to increase the operating time and amount of LAW glass produced from minimum order quantity feeds by ~25%. The impact on the Balance of Mission is expected to be even larger. Other benefits include reduced worker dose commensurate with the reduced operating time and reduced frequency of melter maintenance and replacement.
17 *	<i>Potential Cost Savings:</i> \$500M to \$1B
18 *	<i>Potential Cost Savings Narrative:</i> LAW vitrification cost savings would include avoidance of ~\$520M in capital construction costs for a second facility plus reduced operating and ILAW disposal costs.
	<i>Technical Basis:</i> Current LAW glass formulations on the RPP-WTP Project are limited by the $\text{Na}_2\text{O} * \text{SO}_3$ concentration product less than 5 wt% constraint. This preliminary empirical constraint was developed by recent glass formulation and melter testing programs, and reduces potential waste loadings of some waste types (e.g., AZ-102 and AN-102) by more than 60%. An estimated 20% additional amount of ILAW glass is expected to be produced from sequentially processing all 177 tanks at the Hanford site. Blending of LAW feeds solutions could reduce the estimated increase in ILAW glass production.
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
20	<i>Environment, Safety, and Health Basis:</i> A reduction in the amount of ILAW product that needs to be processed, and less frequent melter maintenance and replacement campaigns, will result in less worker dose.
21	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated

	additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22 *	<p><i>Milestones:</i></p> <p>Tri-Party Agreement commitments:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Commercial Operation-Phase 1 Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Immobilize remaining tank waste 2028 • Close all tanks 2032
23 *	<i>Material Streams:</i> ID-3857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).
25	<i>Major Contaminants:</i> The major radioactive contaminants in the Hanford tank supernatant and salt cake wastes prior to pretreatment include Cs, Tc, Sr, and TRU.
26	<i>Contaminated Media:</i> Any equipment (e.g., precipitation tanks, ion exchange column, liquid-liquid extraction contactors) used in the sulfate separation process will be contaminated internally from the LAW feed. The equipment can likely be designed so that it can be contact maintained.
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	<i>Earliest Date Required:</i> Early technology insertion is possible if completion occurs by 2005
29 *	<i>Latest Date Required:</i> To support BOM WTP design decisions and future operations, a FY 2008 completion date will be required
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> The current baseline technology for LAW sulfate mitigation is a conservative process approach that limits the waste loadings in LAW glasses such that the product of the wt% of Na₂O times the wt% SO₃ in the glass does not exceed 5. Glasses meeting this constraint are generally processable without formation of a sulfate salt layer.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
33	<i>Completion Date Using Baseline:</i> Plant operations will be completed between 2028 and 2040.
Points of Contact (POC)	

34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo Rudy Carreon@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie M Mauss@rl.gov
36 *	<i>Other Contacts:</i> S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen A Wiegman@rl.gov M.E. (Michael) Johnson, CH2M HILL Hanford Group, Inc., 509-372-3628, F/509-376-1788, Michael E Johnson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Advanced Immobilization for LAW to Reduce BOM Cost
2 *	<i>Need Code:</i> RL-WT121
3 *	<i>Need Summary:</i> Development and knowledge of complimentary waste forms to borosilicate glass for immobilizing of low-activity waste could reduce RPP life cycle costs and accelerate the completion of the balance of mission. These waste forms could potentially be used to immobilize waste not suitable, or cost-effective, for treatment by the initial Phase 1 baseline plant and could avoid the need for a second LAW vitrification plant.
4 *	<i>Origination Date:</i> FY 2001 (November 27, 2000)
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Office of River Protection - Treat Waste Balance of Mission <i>PBS No:</i> ORP-TW07
9	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> The Hanford River Protection Project is proceeding with the design and construction of the Waste Treatment Plant for high-level and low-level waste vitrification. Under the current plan, well-defined borosilicate waste forms and joule-heated melter technology has been selected to immobilize Hanford LAW. While this initial Waste Treatment plant has a design life of 40 years, additional LAW immobilization capacity is needed to treat all of the Hanford LAW during the balance of mission. For the waste to be immobilized in the balance of mission, significant reductions in the life-cycle cost and schedule could be achieved with an improved LAW form. The concentration of Hanford LAW that can be immobilized in borosilicate glass is primarily limited by the allowable concentrations of sulfur and sodium in the melter feed. Improved glass or crystalline (mineral or synthetic) waste forms that can incorporate these components along with the rest of the LAW waste feed are desirable. A suitable alternative waste form must be capable of forming a stable, durable material with a minimum of waste dilution. The waste must be easy to process under remote handling conditions and should not be corrosive to melters or other processing equipment.

	The waste form must be able to be processed in the existing LAW vitrification facility or be fashioned to be retrofitted into the facility or auxiliary facility at a cost that is significantly lower than the construction of a new LAW vitrification facility.
13	<i>Functional Performance Requirements:</i> To assure significant gains over that expected from the current process, improved waste forms and their processing equipment should achieve twice the throughput at the same or reduced cost. In addition, the improved waste forms will need to meet the intent of the ILAW product specifications (e.g., chemically stable waste form in a compact and durable disposal package) and be acceptable in terms of final ILAW volume, maturity of technology, ability to install in a shielded facility, waste form chemical and physical stability, life cycle cost, stakeholder acceptability, and time required to deployment. The waste form must be compatible with the Hanford site near surface burial facility in that it must meet or exceed all release requirements for that facility and not adversely impact other facility components (e.g., the borosilicate glass). In addition, the waste form must meet land disposal requirements.
14	<i>Definition of Solution:</i> Acceptable solutions will be achieved when waste forms have been developed and demonstrated to meet the requirements, and when processing technologies have been developed, demonstrated, and evaluated at roughly 1/10 full scale.
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA)
16	<i>Potential Benefits:</i> A limited number of superior waste forms can significantly reduce costs by increasing the capacity and flexibility of the baseline treatment plant, minimizing final waste volumes, and simplifying pretreatment processes. Waste forms with comparable chemical durability to borosilicate glass can reduce the risk of contamination to the environment. Insertion of improved technology prior to treating the balance of mission waste could avoid the construction of a second LAW vitrification facility.
17	<i>Potential Cost Savings:</i> LAW vitrification cost savings would include avoidance of ~\$520M in capital construction costs for a second facility plus reduced operating and ILAW disposal costs.
18	<i>Potential Cost Savings Narrative:</i> With the WTP annual operating cost expected to be in the hundreds of millions of dollars, minimizing plant start up or down time will be a key potential savings, easily measured in the tens of millions of dollars.
	<i>Technical Basis:</i> Current baseline technology requires waste forms to be produced with reduced waste loadings as a compromise to the technology. Resolution of this need will significantly increase WTP flexibility and technical and economic performance.
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A key element for completing treatment of the all of the Hanford waste is to reduce the life-cycle cost through inclusion of improved technologies.
20	<i>Environment, Safety, and Health Basis:</i> Reduced ILAW packages reduce the risks to workers and the environment. Reduced operating periods will reduce worker exposure and a reduced facility life.
21	<i>Regulatory Drivers:</i> Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure for additional double shell tanks. Other regulatory drivers include gathering the data necessary for

	the regulatory permits required for the startup and operation of the facility.
22 *	<p><i>Milestones:</i></p> <p>Tri-Party Agreement commitments:</p> <ul style="list-style-type: none"> ● Start (Hot) commissioning-Phase I Treatment Complex 12/2007 ● Start Commercial Operation-Phase 1 Treatment Complex 12/2009 ● Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> ● Immobilize remaining tank waste 2028 ● Close all tanks 2032.
23 *	<i>Material Streams:</i> ID-3857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant
25	<i>Major Contaminants:</i> Fission products, actinides, nitrate
26	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge.
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	<i>Earliest Date Required:</i> Early technology insertion is possible if completion occurs by 2005
29 *	<i>Latest Date Required:</i> To support Phase 2 operations, a FY 2008 completion date will be required.
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> The current technology is a joule-heated melter that employs bubblers to increase production rates. Current technologies will product an estimated 72,000 containers (185,000 m³) of ILAW. Plant operations will be completed between 2028 and 2040.</p> <p>Technology Insertion Point(s): N/A</p>
31	<i>Life-Cycle Cost Using Baseline:</i> The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system.
33	<i>Completion Date Using Baseline:</i> Plant operations will be completed between 2028 and 2040.
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<p><i>DOE End User POCs:</i></p> <p>R.(Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo Rudy Carreon@rl.gov</p> <p>E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov</p> <p>B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie M Mauss@rl.gov</p>
36 *	<p><i>Other Contacts</i></p> <p>S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen A Wiegman@rl.gov</p>

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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Fast Analytical Methods for Waste Processing
2 *	<i>Need Code:</i> RL-WT122
3 *	<p><i>Need Summary:</i> High-level waste (HLW) stored in underground tanks at a number of DOE facilities is or will be vitrified . The glass must satisfy the Waste Acceptance Product Specifications (WAPS) . One rate-limiting step in the process is analyzing samples of the HLW feed to determine the required glass formers, additives, and— composition so the expected glass will satisfy the WAPS. Analyses also show the products compliance with the WAPS according to the quality assurance provisions delineated in the Quality Assurance Requirements Document (QARD or RW-0333P). There are a number of approaches available for showing compliance including glass sampling and analysis (as performed at West Valley) and melter feed sampling and analysis (as performed at the Defense Waste Processing Facility, DWPF).</p> <p>Filling this need will aid the RPP-WTP project to optimize process control and compliance. Improved methods will reduce the analysis time for samples of the melter feed, reduce overall processing time, accelerate the vitrification process, and reduce costs</p> <p>If it becomes necessary to increase the throughput of the plant beyond the initial design capacity, feed qualification and monitoring technologies would limit the process. Faster analytical and monitoring methods are needed so that more rapid processing is an option.</p>
4 *	<i>Origination Date:</i> FY 2002 (November 15, 2001) (formerly RL-WT099-S, November 30, 2000)
5 *	<i>Need Type:</i> Science Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Office of River Protection - Treat Waste Balance of Mission <i>PBS No:</i> ORP-TW07
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> To perform the activities necessary to remediate the Hanford tank waste, DOE assigned responsibility to the Office of River Protection (ORP) in Richland, Washington. DOE has extended a contract for the design, construction, and commissioning of a new Waste Treatment and Immobilization Plant (WTP) that will treat and immobilize the waste for ultimate disposal. The WTP is comprised of four major elements, pretreatment, LAW immobilization, HLW immobilization, and balance of plant facilities.
12	<i>Need/Problem Description:</i> Chemical and radiochemical analysis of pretreated waste feeds (both

	<p>HLW and LAW) on a batch-wise basis is currently planned to confirm compliance with product quality requirements prior to vitrification. This could be done by analyzing pretreated waste feeds and glass forming additives separately, or by sampling and analyzing the melter feed after blending with glass formers. Currently, analytical turnaround times for analysis of blended melter feed are too long (i.e. 24 – 40 hours or more) and could lead to a bottle-neck in feed processing rates. Rapid analysis methods are needed to determine the concentration of key chemical constituents that will be present in the glass at 0.5 wt% or greater, and radionuclides present at 0.05 % or more of total curies in the final waste form. Alternatively, a rapid analysis method could be used in conjunction with other waste characterization data by measuring key analytes on a batch-wise basis and correlating results to characterization data.</p> <p>Methods for rapid chemical and/or radiochemical analysis of blended melter feeds would also be useful for process control of the vitrification process. This could be accomplished by analyzing for a limited set of chemical constituents that are typically measured to characterize waste glasses. Currently, ICP-AES or ICP-MS is used to analyze 10 to 15 metals for this purpose. Either dissolved feed slurry samples or dissolved glass samples can be used for analysis. Methods to speed up, or eliminate sample dissolution would be one way to address this need.</p> <p>Accelerated vitrification is being considered, but could not take place without also accelerating the characterization process. On-line, or faster analyses would enable shorter process times, reducing costs by accelerating the overall vitrification process. In addition, better process control would reduce down time and improve process reliability.</p>
13	<p><i>Functional Performance Requirements:</i> Methods are needed to significantly reduce sample turnaround time to less than 10 hours per analysis. The methods should be capable of measuring analytes that would be present in the feed material and glass at the levels described in the Waste Acceptance Product Specifications for High-Level Waste (WAPS) .</p> <p>Process control methods are also needed. These require analyzing for a subset of components to provide confidence that acceptable glass would be produced in accordance with the RPP-WTP Project strategy for compliance with waste form requirements. The most current description of compliance strategies for ILAW and IHLW can be found in the RPP-WTP Products and Secondary Wastes Plan (PSWP) for ILAW and the Waste Form Compliance Plan for IHLW (WCP).</p> <p>For either purpose, the methods must be capable of providing data, with high confidence of the composition of the melter feed and the glass products.</p>
14	<p><i>Definition of Solution:</i> This task should result in methods that will significantly reduce analysis times (e.g. > 2-fold) such that overall waste processing is accelerated. New proposed technologies might include, but are not limited to faster analytical chemistry methods, faster analysis strategies, sensors, or inferential methods (physical monitoring methods which accurately characterize key waste stream parameters).</p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Solution of this need will reduce the sample analysis time, support other activities for increasing throughput, and enhance process control of the LAW / HLW vitrification facilities.</p>
17 *	<p><i>Potential Cost Savings:</i> Savings could be greater than \$1 billion dollars when deployed to enable increased waste treatment plant throughput.</p>
18 *	<p><i>Potential Cost Savings Narrative:</i> Cost savings will be realized during operations. Improved</p>

	sample analysis times will reduce processing delays and/or delays in re-adjustment of melter feed batches. For a project that estimates a 20-50-billion dollar life cycle operating budget, the potential savings for rapid analyses are in the billions of dollars. Seeking to increase WTP throughput beyond the initial design capacity will also shorten the mission resulting in significant cost savings
	<i>Technical Basis:</i> The HLW melter feed will be a chemically and physically complex slurry. Other DOE facilities that process similar wastes (West Valley and DWPF) apply relatively old technology and are a smaller scale to that expected on the RPP-WTP. DWPF has experienced delays in vitrification production due to the turn-around time required for melter feed sample acquisition and analysis.
19	<i>Cultural/Stakeholder Basis:</i> The River Protection Project is committed to moving forward to design, construct, and put into operation the Waste Treatment and Immobilization Plant on the schedule recently agreed to in the Tri-Party Agreement. A robust program is necessary to ensure that delays, all of which are costly, are minimized. A key part of this risk mitigation is to include in the total program a capability to test with actual wastes the processes and equipment planned, or later in use.
20	<i>Environment, Safety, and Health Basis:</i> An optimal melter feed system design will minimize the inventory of melter feed while providing adequate hold-up to ensure tank contents are homogeneous. Optimization of the number and size of samples is also advantageous from a safety viewpoint. Statistically proven demonstration that a compliant glass product will be generated will provide confidence to regulators and facilitate their acceptance of the proposed compliance strategy.
21	<i>Regulatory Drivers:</i> HLW product compliance strategy acceptance by DOE-RW. Meet TPA schedule for HLW immobilization. Environmental Impact Statement (EIS) for the Tank Waste Remediation System (TWRS) (DOE-RL and Ecology 1996) and the Hanford Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and its amendments. DOE has negotiated additions to the Tri-Party Agreement that require the retrieval of single shell tanks by 2018, and the startup and operation of the WTP to support the treatment and immobilization of tank waste. By operating the WTP not only is that capability demonstrated and about 10% by volume (25% by activity) of the tank waste processed, but space is made available in the double shell tanks to allow the single shell tank retrieval to proceed without the expenditure of vast sums for additional double shell tanks. Other regulatory drivers include gathering the data necessary for the regulatory permits required for the startup and operation of the facility.
22 *	<p><i>Milestones:</i></p> <p>November 15, 1999 Tri-Party Agreement:</p> <ul style="list-style-type: none"> • Start (Hot) commissioning-Phase I Treatment Complex 12/2007 • Start Operation-Phase I Treatment Complex 12/2009 • Complete Phase I-Treatment (no less than 10% of the tank waste by volume and 25% of the tank waste by activity) 12/2018 <p>Other selected TPA milestones are:</p> <ul style="list-style-type: none"> • Immobilize remaining tank waste 2028 • Close all tanks 2032
23 *	<i>Material Streams:</i> ID-3857 HLW to Treatment Risk Score: 3
24	<i>TSD System:</i> Hanford Waste Treatment and Immobilization Plant. Technical risk is timely startup of this plant and its ability to operate at planned throughput (capacity and operating efficiency).

25	<i>Major Contaminants:</i> Fission products, actinides, nitrate
26	<i>Contaminated Media:</i> Tank waste consisting of supernate (liquid), salt cake, and sludge. Hanford HLW is contaminated with a variety of radionuclides such as ⁹⁰ Sr, transuranics and lanthanides. Many tanks also contain regulated inorganic and/or organic components.
27	<i>Volume/Size of Contaminated Media:</i> The Hanford Site has 177 underground tanks that store 204 million liters (54 M gallons) of waste containing about 190 MCi of activity.
28 *	<i>Earliest Date Required:</i> 10/2001 Rapid analytical methods will be needed during radioactive operations of the RPP-WTP, but will need to be tested and qualified in advance of production operations. Prototypic testing of the feed preparation systems, including blended feed sampling and analysis will begin in FY2002 (10/2001).
29 *	<i>Latest Date Required:</i> 12/2009 Support Hot Commissioning (which must be completed in 12/2007) and subsequent operation leading to Commercial Operation (which must be started by 12/2009).
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> The current baseline consists of in-lab analyses of dissolved melter feed slurries or feed slurries converted to glass. Typically acid dissolution and/or caustic fusion followed by ICP-AES or ICP-MS for metals and GEA, separation and beta counting, and alpha energy analysis for radionuclides. Organic analyses are also planned to take place in-lab. <i>Technology Insertion Point(s):</i> N/A
31	<i>Life-Cycle Cost Using Baseline:</i> : The current baseline for the WTP is several billion dollars, with the BNI estimate itself is in the \$4 billion range. The current River Protection Project life cycle costs are estimated at approximately \$50 billion. With exclusively in-lab analyses, processing could become a rate-limiting step. Faster analyses could greatly reduce overall processing times and operating costs.
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> There is large uncertainty in the WTP life-cycle cost, providing the opportunity to reduce the life-cycle cost due to operation improvements as well as ensuring operational success not to add additional cost to the system
33	<i>Completion Date Using Baseline:</i> Plant operations will be completed between 2028 and 2040.
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i>
35	<i>DOE End User POCs:</i> R. (Rudy) Carreon, DOE-ORP, 509-373-7771, F/509-373-0628, Rodolfo Rudy Carreon@rl.gov E.J. (Joe) Cruz, DOE-ORP, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov B.M. (Billie) Mauss, DOE-ORP, 509-373-5113, F/509-372-2781, Billie M Mauss@rl.gov
36 *	<i>Other Contacts:</i> S.A. (Steve) Wiegman, DOE-ORP, 509-372-2536, F/509-372-2781, Stephen A Wiegman@rl.gov M.E. (Michael) Johnson, CH2M HILL Hanford Group, Inc., 509-372-3628, F/509-376-1788, Michael E Johnson@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

FY 2002 TANKS SCIENCE NEEDS

SAFE STORAGE

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Double Shell Tanks (DST) Corrosion Chemistry
2 *	<i>Need Code:</i> RL-WT079-S
3 *	<p><i>Need Summary:</i></p> <p>Tank waste chemistries and temperatures within the DST operating limits for corrosion control and operating temperature range may not provide the expected corrosion protection, necessitating the need to evaluate future operations for the conditions outside the existing corrosion database. Such studies will help in assuring the availability of the DSTs to support future waste retrieval missions. Future tank waste operations are expected to process wastes that are more dilute with respect to some of the corrosion inhibiting waste constituents. Therefore, this need calls for the implementation of an effort to evaluate three aspects of the chemistry control program, by understanding the nitrite and hydroxide depletion reactions, by developing empirical equations from depletion reaction models, and lastly, through laboratory testing provide recommendations to enhance the corrosion control limits. This two-year investigative and laboratory corrosion testing effort will encompass additional time needed to assemble analytical and empirical information, design the test program, and complete data analysis and final reporting. The tests will be conducted on simulated (non-radioactive) wastes with chemistries bounding the variations of chemistry in current DSTs and bridging to dilute waste chemistries expected in the future at temperatures covering the current and future DST operating ranges. Analytical and tank waste sampling data will be evaluated to determine probable chemistry reactions and behavior models.</p> <p>The waste in double-shell tank (DST) 241-AN-107 had been outside corrosion chemistry control limits for several years. However, limited UT examination performed in 1998 indicated the tank to be corroding at a very low rate with no observable pitting or stress corrosion cracking (SCC). The UT results were supported by the more recent examination of corrosion probe coupons removed from tank 241-AN-107 after approximately 4 years of exposure to tank waste. The coupon analysis indicated very little general corrosion in tank waste with no observable pitting and SCC. This suggests that the current DST waste chemistry limits may be conservative. Several tanks currently contain sludges with interstitial liquids that fall outside the chemistry control limits and with limited means available for adjusting the waste composition. Recent sample results from tank 241-AY-102 identified that sludge interstitial liquid nitrite composition had been depleted. This nitrite depletion is speculated to be the result of organic reactions with the nitrite. Empirical equations representing the organic hydroxide depletion reaction have been developed as well as empirical assessment of organic nitrite waste characterization. Further understanding as to the cause of such reactions is needed to enhance the chemistry control program. Previous studies by Pacific Northwest National Laboratory have identified dilute waste chemistries promoting excessive corrosion attack, and more concentrated wastes producing high corrosion rates at temperatures above the normal DST operating temperature range. The investigative and laboratory studies will address the two types of steel (A515/516, A537) used in the construction of the DSTs, the past thermal and operational history of the tanks, and future projected uses.</p> <p>This corrosion control issue will affect all of the dilute waste storage tanks at Hanford, and may ultimately impact all 28 DSTs.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Science Need

6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Safe Storage/Tank Farm Operations PBS No: RL-TW03
9	<i>National Priority:</i> <u> X </u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u> </u> 2. <u>Medium</u> - 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). <u> </u> 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> High
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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	<i>Need/Problem Description:</i> Corrosion control of DSTs is accomplished by operating the tanks within the corrosion chemistry control limits. Monitoring the chemistry of tank waste is performed using process knowledge and tank sampling. Tanks found to be within chemistry specification limits are considered to be not at risk for excessive corrosion damage. However, four DSTs are currently operating with low hydroxide (out of corrosion specification) concentration and one of these tanks is also operating with low nitrite concentration. Tank samples are taken at a minimum frequency of every 5 years and their analysis is difficult and expensive. Process knowledge is complicated because of waste streams (notably line flushes and process condensate recycle) that are exempt from the corrosion control specifications. The laboratory database for the corrosion control chemistry specifications is 20 years old and was formulated on waste chemistries no longer produced at Hanford. As tank waste chemistries change over time, they drift to the fringes of the acceptable envelope for corrosion control. There is increasing evidence that these new waste chemistries (including those of the future waste operations) have corrosion characteristics that cannot be reliably predicted from the models developed by the old laboratory studies. New laboratory studies need to be conducted to better characterize the conditions of the future waste tank operations and the changing waste chemistry conditions of the present tank wastes. Chemical changes occur in the waste over time to deplete corrosion inhibiting chemicals (hydroxide and nitrite). An understanding of these depletion reactions is needed to develop empirical equations and depletion models that can be used to predict the changing chemistry of DST wastes. These equations and models will serve as tools to ensure timely corrective actions will be taken to keep the tank wastes within the corrosion control chemistry limits. Maintaining

	<p>the DST waste chemistries in compliance with corrosion control limits reduces the risk of tank failure and helps to ensure availability of tanks for future retrieval and waste treatment operation.</p> <p>*** Program Baseline Summary (PBS) No.: RL-TW03 *** Work Breakdown Structure (WBS) No.: 5.01.03.05 *** TIP No.: T03-01-100</p> <p>Consequences of Not Filling Need: Regulatory Impacts Waste compatibility is one area that must be addressed in tank system integrity assessments, per Washington Administrative Code (WAC) Dangerous Waste Regulations (WAC 173-303-640).</p> <p>Programmatic Impacts Corrosion control of DSTs is accomplished by operating the tanks within the corrosion chemistry control limits. Monitoring the chemistry of tank waste is performed using process knowledge and tank sampling. The finding of no significant wall thinning in a limited ultrasonic examination of 241-AN-107 coupled with negligible corrosion observed in corrosion probe coupons exposed in 241-AN-107 waste, which is not in compliance with current waste chemistry limits, suggest that corrosivity of wastes in Hanford's waste storage tanks may not be sufficiently well understood and the present corrosion chemistry control limits may be conservative. There are several tanks (with limited capability for making adjustments) that contain sludges outside the chemistry control limits and the corrosion behavior of these sludges is unknown. Tank samples are taken at an established frequency and their analysis is difficult and expensive. Process knowledge is complicated because of waste streams that are exempt from the corrosion chemistry control limits.</p>
13	<p><i>Functional Performance Requirements:</i> The proposed laboratory study will establish the waste composition limits for the DSTs to control corrosion process at acceptable levels during the future waste retrieval and treatment missions at the Hanford Site. Excessive corrosion will specifically be defined as:</p> <ul style="list-style-type: none"> • Any evidence of stress corrosion cracking. • Any evidence of the onset of pitting. • Uniform corrosion rates of greater than 1 mil per year. <p>Privatization Potential: There is limited privatization potential for the results of this laboratory corrosion study.</p>
***	<p><i>Schedule Requirements:</i> Work is to be initiated in fiscal year 2002 and completed by fiscal year 2004.</p>
14	<p><i>Definition of Solution:</i></p>
15 *	<p><i>Targeted Focus Area:</i> Tanks Focus Area (TFA)</p>
16	<p><i>Potential Benefits:</i> Extended tank life, delayed cost of new tanks.</p>
17	<p><i>Potential Cost Savings:</i> See narrative below.</p>
18	<p><i>Potential Cost Savings Narrative:</i> The existing Technical Safety Requirement (TSR) for DSTs prescribes waste chemistry requirements for the purpose of limiting corrosivity, and prolonging tank life. The DSTs will be needed well beyond their design life to support the future waste retrieval and treatment missions at the Hanford Site. Construction of new waste storage tanks could be required if remaining</p>

	<p>tank life is projected to fall short of the projected River Protection Project (RPP) mission duration. The estimated cost to build a new 6-tank farm (Multi-Function Waste Tank Facility) was \$435 million in 1993 dollars. It is difficult to quantify the benefit (in dollars) of gaining an improved understanding of DST corrosion chemistry. However, it is clear that decisions on corrosion inhibitor addition and DST replacement, which necessarily require an understanding of the effects of waste chemistry on tank corrosion, have the potential to significantly impact RPP life cycle costs in the range of 100s of millions of dollars. Improved understanding of the effect of DST waste chemistry on tank corrosion would improve the underlying justification for those decisions.</p>
19	<p><i>Cultural/Stakeholder Basis:</i> Given the history of single-shell tank failures and resulting contamination of soil and groundwater, uncertainty regarding effects of DST waste chemistry on corrosion and potential DST failure could raise stakeholder concerns.</p>
***	<p><i>Technical Basis:</i> The laboratory database for the corrosion control chemistry specifications is 20 years old and was formulated on waste chemistries no longer produced at Hanford. As tank waste chemistries change over time, they drift to the fringes of the acceptable envelope for corrosion control. There is increasing evidence that these new waste chemistries (including those of the future waste operations) have corrosion characteristics that cannot be reliably predicted from the models developed by the old laboratory studies. New laboratory studies need to be conducted to better characterize the conditions of the future waste tank operations and the changing waste chemistry conditions of the present tank wastes.</p> <p>DOE Order 5820.2A, <i>Radioactive Waste Management</i>, requires monitoring of cathodic protection systems, methods for periodically assessing waste storage system integrity, and adjustment of waste chemistry to control corrosion.</p> <p>DOE-STD-1073-93, <i>Configuration Management</i>, requires implementation of a Material Condition and Aging Management Program to control aging processes in major equipment and components. The primary aging processes in waste tank systems are corrosion related.</p> <p>DOE/RL-92-60, <i>Tank Waste Remediation System Functions and Requirements</i> contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions.</p>
20	<p><i>Environment, Safety, and Health Basis:</i></p> <p>HNF-SD-WM-TSR-006, <i>Tank Farms Technical Safety Requirements</i>, Administrative Control 5.15, <i>Chemistry Control Programs</i>. This document contains operational safety requirements – administrative controls for corrosion control, cathodic protection, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.</p> <p>RPP-8173, Rev. 1, <i>Technical Basis for Caustic Additions to tanks 241-AN-102, 241-AY-101, 241-AY-102, and 241-AN-107 – Draft</i>, discusses the principal corrosion mechanisms (uniform corrosion, pitting, and stress corrosion cracking) that play an active role in DST primary wall corrosion and provides estimates of remaining useful lives for these tanks.</p> <p>RPP-7795, Rev. 1, <i>Technical basis for chemistry control Program</i>. This document discusses current waste composition and sampling requirements to maintain the waste chemistry within specification, depletion mechanisms, and empirical equations used to estimate the rate of depletion of free hydroxide in the tank waste.</p> <p>BNL/DOE-HQ Tank Structural Integrity Panel, <i>Guidelines for Development of Structural</i></p>

	<i>Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT</i> , discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.
21	<p><i>Regulatory Drivers:</i> <i>Washington Administrative Code 173-303-640(2)(c)(iii)</i> requires consideration of existing corrosion protection when performing tank system integrity assessments.</p> <p>HNF-SD-WM-OCD-015, <i>Tank Farm Waste Transfer Compatibility Program</i>, describes decision rules relating to waste transfers into and within the DST system. The document defines a means of consistently applying safety, operational regulatory and programmatic criteria and specifies considerations necessary to assess waste transfers.</p> <p>BNL/DOE-HQ Tank Structural Integrity Panel, <i>Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT</i>, discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.</p>
22	<i>Milestones:</i> N/A
23	<i>Material Streams:</i> Tanks and Residuals, HLW-HANF-3 (Double Shell Tanks); sludge, salt, liquid (RL-HLW-20)
24	<i>TSD System:</i> Double Shell Tanks
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> N/A
27	<i>Volume/Size of Contaminated Media:</i> 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*	<i>Earliest Date Required:</i> 1/1/2001
29 *	<i>Latest Date Required:</i> 10/1/2004
Baseline Technology Information	
30	<p><i>Baseline Technology/Process:</i> Corrosion control of DSTs is accomplished by operating the tanks within the corrosion chemistry control limits. Monitoring the chemistry of tank waste is performed using process knowledge and tank sampling. Sample results for hydroxide, nitrite and nitrate concentrations are compared to established operational limits. A tank is currently considered to be not at risk for excessive corrosion if the chemistry is within the specified limits.</p> <p>Technology Insertion Point: T03-01-100</p>
31	<i>Life-Cycle Cost Using Baseline:</i> \$1,850K
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i> -50% to +100%
33	<i>Completion Date Using Baseline:</i> 10/1/2004
Points of Contact (POC)	
34	<p><i>Contractor End User POCs:</i> K. G. (Kelly) Carothers, CHG, (509) 373-4556, Kelly_G_Carothers@rl.gov</p>
35	<p><i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov Mark L. Ramsay, DOE-APO, 509-376-7924, Mark_L_Ramsay@rl.gov</p>

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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

CLOSURE

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Moisture Flow and Contaminant Transport in Arid Conditions
2 *	<i>Need Code:</i> RL-WT035-S
3 *	<i>Need Summary:</i> To understand the movement of contaminants through zones of low moisture (region-wide saturation less than 10%) for use in risk assessments. Most of the work concerning moisture flow and contaminant transport has been done at sites important for agriculture, i.e., sites having moisture contents near saturation. Thus, the theories and equations for moisture flow and contaminant transport are modifications of theories and equations for fully saturated environments. In such an environment, it is movement through the pore spaces between soil particles that is dominant. Under very dry conditions, the interactions with the soil particles will become more important. Tested theories and equations are needed for use in performance assessment in order to predict moisture movement and contaminant transport.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Science Opportunity
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Disposal and Closure PBS No.: RL-TW09, TW11
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters. 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	<i>Need/Problem Description:</i> Theories of moisture flow and contaminant transport are extrapolated from theories in which the soil pores (the conduits for moisture flow) are nearly filled with water.

	<p>For the dry conditions expected at arid Western sites, the pores will be nearly empty (having only a thin water film on soil particle surfaces). The movement of water in liquid and vapor phases and retention of water on particle surfaces must be understood in order to predict how the water moves through such systems. Volumetric moisture contents are expected to be less than 10%. At such low moisture contents, the conductivity is expected to be extremely low, necessitating specialized measurement techniques. Measurements of hydraulic parameters (conductivity and moisture retention) of both sediments (e.g., Hanford formation sands and Hanford formation gravels, clastic dike materials and Ringold Formation strata) as well as disposal facility materials (e.g., fractured glass and structural materials) are necessary to create a data base from which an understanding can be developed. The movement of water in both liquid and vapor phases is of interest because of the high salt content of many DOE waste types and forms. On degradation, waste containing high salt contents may raise the salt content of soil moisture in the liquid phase, causing soil vapor to be drawn to the waste. However, the formation of secondary minerals could consume soil water, and thus a limited supply of soil water could decrease the release process. The physics of multiphase water flow and the tradeoffs between vapor phase flow and waters of reaction must be better understood to quantify the potential releases from waste forms.</p> <p>The retardation of contaminants in actual soils under natural conditions must be understood for dose calculations. Measurement of retardation factors for important contaminants (Tc, Se, U, Cs, and Sr) must be measured as a function of moisture content as well as of chemical and physical form. An understanding of the soil physics must be obtained that will allow the calculation of such dependencies for other soils so that the need for further measurements is minimized.</p> <p>This need is described in Section 10.3.7 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Conservative methods and data will be used in the performance assessments, likely requiring more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities.</p> <p>Program Baseline Summary (PBS) No.: TW09, TW11 *** Work Breakdown Structure (WBS) No.: 5.04.01.03, 5.05.01.01 *** TIP No.: TIP 0001 (RL-ER01), TIP 0002 (RL-ER02), TIP 0003 (RL-ER03)</p>
13	<p><i>Functional Performance Requirements:</i> Many waste disposal sites in the western United States are located in dry climates in which volumetric soil water contents are less than 10%. Both the movement of water and the sorption potential of contaminants under these very dry conditions are poorly understood, yet knowledge of both processes is vitally important for predicted contaminant transport for risk assessments.</p> <p>Moisture flow is the driving force for contamination release from waste and the transport of the contaminants. This flow (as both liquid and vapor) is poorly understood under the arid conditions frequently found in western sites used for waste disposal and especially for fractured media. In particular, for those arid sites where moisture barriers or diverters are used, the theory and parameters describing liquid and vapor flow under very dry conditions need to be better understood.</p> <p>Many contaminants are retarded in the soil by geochemical interactions. Such interactions are usually measured under saturated conditions. However, experiments at the Pacific Northwest National Laboratory have indicated that the retardation of uranium for various Hanford soils varies with the moisture content and with the type of soil. Moreover, retardation is known to depend on the chemical and physical form (e.g. charge and oxidation state, attachment to a colloid). However, it is</p>

	not known how these effects vary with moisture content.
	Outsourcing Potential: Potentially high. Research will aid many waste management areas, particularly those in arid and semi-arid Western states.
	** <i>Schedule Requirements:</i> For use during the maintenance phase of Hanford Immobilized Low-Activity Tank Waste Performance Assessments, such data and testing are needed by 2005. Information for tank farm assessments and for 200 Area Remediation sites are needed in a similar time frame.
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> Indeterminate
18 *	<i>Potential Cost Savings Narrative:</i> Less conservative values for hydraulic properties and recharge rates in and around disposal facilities will allow less stringent release contaminant specifications for the Phase II immobilization Request for proposals (and hence lower product costs to DOE) as well as less stringent requirements for waste disposal facility design.
	** <i>Technical Basis:</i> Provide technical basis for characterizing the distribution of hydraulic properties and recharge rates in and around the waste sites at Hanford, including the tank farms, ILAW disposal site, and the numerous past practice sites under the 200 Area Remediation Program. Such information will also be required for other waste management actions involving subsurface disposal.
19	<i>Cultural/Stakeholder Basis:</i> The stakeholders have expressed concerned that the Hanford Site does not under the conceptual model for moisture flow and contaminant transport through the vadose zone. Moreover, they are worried that the codes used to implement these conceptual models are inadequate.
20	<i>Environment, Safety, and Health Basis:</i> Moisture flow is the main means for dissolution/release of contaminants from waste and the transport of those contaminants to groundwater.
21	<i>Regulatory Drivers:</i> Performance assessments are required by DOE Order 435.1 as well as RCRA and CERCLA. Composite analyses, which also require knowledge of recharge, are also required under the new DOE order. The Washington State Department of Ecology and the Environmental Protection Agency have expressed concerned that the Hanford Site does not under the conceptual model for moisture flow and contaminant transport through the vadose zone.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
23 *	<i>Material Streams:</i> 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	<i>TSD System:</i> 200 Area liquid discharge sites; ILAW disposal facility; SST farms; DST farms
25	<i>Major Contaminants:</i> Not applicable
26	<i>Contaminated Media:</i> Hanford vadose zone, Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge
27	<i>Volume/Size of Contaminated Media:</i>
28 *	<i>Earliest Date Required:</i> ASAP

29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Laboratory measurements of hydraulic and chemical properties on small cores. <i>Technology Insertion Point(s):</i> TIP 0001 (RL-ER01), TIP 0002 (RL-ER02), TIP 0003 (RL-ER03)
32	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG., 509-372-9204, F/509-372-9447, Frederick m mann@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip e lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949, F/509-373-1313, robert w lober@rl.gov
36 **	<i>Other Contacts:</i> K.A. (Ken) Gasper, CHG, 509-3731-1948, 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

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Distribution of Recharge Rates
2 *	<i>Need Code:</i> RL-WT044-S
3 *	<p><i>Need Summary:</i> Fundamental data to improve confidence in the estimation of recharge rates as a function of time and space for use in impact assessments under realistic conditions. The rate at which moisture exits the surface root zone of soil and enters into the subsurface (often called the recharge rate) is often the major parameter (along with inventory) determining the rate at which contaminants enter groundwater. This is particularly true in dry climates. The recharge rate is known to depend upon many parameters (for example, type and condition of surface soil, type and extent of vegetation, climate). However, this dependence is usually determined for idealized conditions and for small spatial and temporal extents. For large sites, such as Hanford where waste disposal covers many acres and where impact calculations must extend beyond thousands of years, such simple descriptions are inadequate to convince the technical community, the regulators, and the stakeholders that impacts can be adequately estimated.</p> <p>Short-term measurements of natural recharge rates at local scales at the Hanford Site range from less than 1 mm/year to basically the precipitation rate (160 mm/year). Longer term measurements (e.g. tracer measurements) have shown a greater variability. Man-made effects (e.g., funneling) as well as topographic features can enhance these values. Furthermore, Hanford Site impacts assessments (e.g. <i>Hanford Immobilized Low-Activity Tank Waste Performance Assessment and Retrieval Performance Evaluation</i>) have shown the dependence of impacts on recharge rate. Such conclusions are reinforced by Hanford Site work for the Nuclear Regulatory Commission on the importance of surface barriers.</p> <p>The same Needs statement was submitted to both the Subsurface Contaminants and Tank Focus Area.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Science Opportunity
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Closure <i>PBS No.:</i> RL-TW09 and RL-TW11
9 *	<p><i>National Priority:</i></p> <p>___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p><u>X</u> 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10	<i>Operations Office Priority:</i>
Problem Description Information	
11	<i>Operations Office Program Description:</i> 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

	<p>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.</p> <p>The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters.</p>
12	<p><i>Need/Problem Description:</i> Measurements at the Hanford Site have shown that the amount of water naturally passing through the upper soil surface depends on the amount of precipitation, soil type and texture, and vegetation cover. A detailed understanding how these variables interact across a sparsely vegetated landscape over long times (thousands of years) and a comparison of such an understanding with estimates of long-term rates (through tracer measurements) is necessary.</p> <p>Also needed is the quantification of:</p> <ul style="list-style-type: none"> • The distribution of recharge throughout the Hanford Site as well as through the waste site, • The variability (uncertainty) possible in the distribution of recharge, and • The time delay between recharge through the land surface and that into the water table. <p>Knowledge of the distribution of recharge throughout the Hanford Site is important because it determines the direction and magnitude of groundwater flow beneath waste sites. Because recharge rate is known to be a significant factor in the release and migration of contaminants, knowledge of the uncertainty in spatial estimates of recharge will contribute to estimates of risk. Finally, because society is becoming more interested in estimates of near-term impacts to the environment, if simulations of contaminant release, migration and fate are to be compared quantitatively to field observations, then the time delay between surface infiltration and groundwater recharge must be taken into account. This will be of greater importance if the prediction of contaminant fate in the next 100 to 1000 years becomes the focal point of assessments of impacts to human health.</p> <p>The time at which contaminants enter the accessible environment is proportional to the rate at which water passes through the soil. For most waste forms, the amount of contaminants is also proportional to this rate as well. Understanding the causes for the rate at which water enters a disposal facility will allow a better design of the disposal facility and better setting of the specifications for the waste form. By varying the specifications for the waste form, procurement costs and disposal facility costs could vary by hundreds of millions of dollars.</p> <p>Production of recharge distributions for the Hanford Site, and perhaps other large DOE sites in the arid and semi-arid Western United States, will enable the inclusion of the spatial variability and uncertainty in a key release and fate parameter (recharge) in an analysis of uncertain health impacts. The importance of recharge rate in the assessment of waste disposal in the arid West has been demonstrated. Our uncertainty in estimates of recharge feeds directly our uncertainty in risk and cost envelopes associated with waste management decisions.</p> <p>Specific requirements are</p> <ul style="list-style-type: none"> • Information is needed to determine net water infiltration for a given waste site at the Hanford Site. The variability may include vegetation dynamics (resulting from disturbances, fires, drought) and its impact on the local and regional recharge rates that

	<p>ultimately control contaminant migration rates. Little has been done to quantify net water infiltration from meteoric sources at waste sites. The spatial and temporal variation of the water infiltration rates, can drastically affect the amount of contaminant moving to groundwater from a given waste site. Such information has been lacking in the predictive modeling of risk and dose from Hanford waste areas and the impact of these variation need to be documented.</p> <ul style="list-style-type: none"> • Means to quantify the distribution of recharge throughout the Hanford Site as well as through an individual waste site, the variability (uncertainty) possible in the distribution of recharge, and the time delay between recharge through the land surface and that into the water table are needed. • The interaction of the factors that affect water recharge variables across a sparsely vegetated landscape over long times (thousands of years) need to be understood and incorporated into estimates of long-term rates of water infiltration. • The impact of future land and water use and potential climate changes on water infiltration needs to be understood and incorporated into modeling efforts to predict the transport of contaminants. <p>This need is described in Section 10.3.6 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Conservative methods and data will be used in impact assessments, likely requiring more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities.</p> <p>*** Program Baseline Summary (PBS) No.: TW09, TW11 *** Work Breakdown Structure (WBS) No.: 5.04.01.03, 5.05.01.01 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i> Recharge water is the primary means for dissolution and release of contaminants from the buried waste and transport of those contaminants to the groundwater. Estimation of these rates is difficult under arid conditions because the rates are very low. In addition, there are significant questions about the adequacy of the estimated recharge rates given the heterogeneity of the environmental processes, the effect of facility features, the uncertainty of climate, and the influence of humans. Furthermore, no attempt has been made to quantify the distribution of recharge rates to enable sounder estimates of the mean and range of rates to be expected during the lifetime of the facility. To satisfy this scientific need, understanding must be provided covering large spatial extents (many acres) and large temporal periods (thousands of years).</p> <p>Outsourcing Potential: Potentially high. Research will aid many waste management areas, particularly those in arid and semi-arid Western states.</p>
	<p>*** Schedule Requirements: Impact assessments are presently being done on the Hanford Site and will be maintained until site closure. Closure assessments are expected to occur until at least post 2020.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> Indeterminate
18 *	<i>Potential Cost Savings Narrative:</i> Less conservative values for hydraulic properties and recharge

	rates in and around disposal and tank farm facilities will allow less stringent release contaminant specifications as well as less stringent requirements for waste disposal facility design.
**	<i>Technical Basis:</i> Defensible, credible estimates for the recharge rate as a function of time are needed for impact assessments required to be performed for the Hanford Site. Previous impact assessments (e.g. <i>Hanford Immobilized Low-Activity Tank Waste Performance Assessment</i> and <i>Retrieval Performance Evaluation</i>) have shown the importance of accurate knowledge of the recharge rate.
19	<i>Cultural/Stakeholder Basis:</i> The stakeholders have expressed concerned that the Hanford Site does not understand the conceptual model for moisture flow and contaminant transport through the vadose zone.
20	<i>Environment, Safety, and Health Basis:</i> Recharge water is the main means for dissolution/release of contaminants from waste and the transport of those contaminants to groundwater.
21	<i>Regulatory Drivers:</i> Impact analyses are required under AEA, CRCLA, NEPA, and RCRA regulations.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
23 *	<i>Material Streams:</i> 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	<i>TSD System:</i> 200 Area liquid discharge sites; ILAW disposal facility; SST farms; DST farms
25	<i>Major Contaminants:</i> Not applicable
26	<i>Contaminated Media:</i> Hanford vadose zone. Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2001
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Point estimates of recharge and laboratory measurements of hydraulic properties on small cores. <i>Technology Insertion Point(s):</i>
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG, 509-372-9204, F/509-372-9447, Frederick_m_mann@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E_J_Cruz@rl.gov P.E. (Phil) LaMont, DOE/ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE/ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov

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*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Getter Materials
2 *	<i>Need Code:</i> RL-WT046-S
3 *	<i>Need Summary:</i> Fundamental data to improve confidence in the getter material performance under realistic conditions.
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Technology Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Retrieval, Disposal and Closure PBS No.: RL-TW04, TW09, TW11
9 *	<i>National Priority:</i> ___ 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. <u>X</u> 2. <u>Medium</u> - 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. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	<i>Operations Office Priority:</i> Medium
Problem Description Information	
11	<p><i>Operations Office Program Description:</i> The overall purpose of the Retrieve and Transfer SST Waste function is to move the waste from the SSTs into preferred storage in the DST system. A primary objective of this function is to develop and test alternative and improved retrieval technologies to past-practice sluicing. As part of this effort, Leak Detection Monitoring and Mitigation (LDMM) approaches are being developed for concurrent deployment. To support this effort Cold Test Training & Mock-up Facilities are being established. The baseline end state of the Retrieve and Transfer SST Waste function is:</p> <ul style="list-style-type: none"> • Retrieval of all wastes from the SSTs • The safe, environmentally compliant transfer of this waste to the DSTs • SSTs in a ready state for implementing closure and final disposal of the SST farms. <p>The overall purpose of the Disposal function is to provide and operate permitted facilities to disposal of immobilized low-activity waste (ILAW), store and prepare immobilized high-level waste (IHLW) for offsite shipment, and dispose of secondary waste from the tank farms and waste treatment plant (WTP), including failed melters.</p> <p>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</p>

	understanding contaminant migration in the vadose zone and groundwater that are part of the Hanford Groundwater/Vadose Zone (GW/VZ) Integration Project.
12	<p><i>Need/Problem Description:</i> Negatively charged elements and compounds (e.g. TcO_4^-, Se^-) are poorly sorbed on most materials under basic ($\text{pH} > 7$) conditions. However, some negatively charged materials (e.g. I^-) do sorb on Hanford soils under basic conditions. An understanding of how important contaminants interact with the soil will aid the development of appropriate materials to retard the transport of those contaminants.</p> <p>If low-cost getter materials can be developed for use in waste disposal, then requirements on waste forms can be reduced, potentially saving hundreds of millions of dollars in the Hanford Immobilized Waste Disposal Program. The Savannah River Site uses FeS to trap technetium, and many disposal sites use concrete to trap uranium.</p> <p>This science need supports RL-WT061 Reactive Barriers to Contaminant Migration.</p> <p>This need is described in Section 10.3.4 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.</p> <p>Consequences of Not Filling Need: Conservative methods and data will be used in the performance assessment, likely requiring more stringent contaminant release specifications in the waste product req for proposal and requiring more expensive disposal facilities. More rigorous and expensive retrieval and closure methods may be required to achieve performance requirements.</p> <p>*** Program Baseline Summary (PBS) No.: TW04, TW09, TW11</p> <p>*** Work Breakdown Structure (WBS) No.: 5.02.01.01.02.02, 5.04.01.03, 5.05.01.01</p> <p>*** TIP No.: TBD</p>
13	<p><i>Functional Performance Requirements:</i> : In order to meet the contaminant release specifications for the disposal of Hanford low-activity tank waste, radioactive contaminants are physically trapped in glass. However, only a few of these radioactive contaminants drive the performance assessment. If these key radioactive contaminants could be chemically trapped after their release from glass, then the performance of the waste disposal system could be significantly improved. Hydraulic properties of getter materials (original, loaded, and discharged) need to be measured to fully understand waste disposal performance in the presence of getters. The use of getter materials in the Savannah River Site's disposal of the Salt-stone waste was an important consideration in the approval of that site's disposal of tank waste.</p> <p>Outsourcing Potential: Once the laboratories (PNNL and SNL) have performed the laboratory analysis and bench scale demonstrations, the technology will be available for field scale demonstration and deployment. It is intended that placement of getter materials in contaminated soils or in tank fill materials would be outsourced to private contractors.</p>
***	<p>Schedule Requirements: For use during the maintenance phase of Hanford Immobilized Low-Activity Tank Waste Performance Assessments, such data and testing are needed by 2005. For tank closure activities, the data and testing are needed by 2008.</p>
14	<i>Definition of Solution:</i>
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> Indeterminate

18 *	<i>Potential Cost Savings Narrative:</i> The cost savings could be significant. With regard to the disposal facility, the cost savings resulting from lowering the design requirements could exceed several hundred million dollars. The cost saving associated with deployment of the getter material in the soil could approach several hundred million dollars depending on the inventory and distribution of contamination resulting from past and anticipated future leaks. Cost savings associated with deployment of getter materials in tank fill materials could be in the tens to hundreds of millions of dollars if more rigorous tank retrieval requirements or tank closure approaches can be avoided by taking advantage of getter materials in reducing release rate.
**	<p><i>Technical Basis:</i> Deployment of sequestering agents could provide an engineering solution for past leaks and retrieval leaks, and for tank fill materials for closure. Deployment of sequestering agents in the matrix or as a liner around the vitrified low-activity waste will reduce the engineering requirements of the disposal facility.</p> <p>Concerns regarding the migration of contaminants from existing subsurface contamination, future leaks from sluicing, or residual waste could impact RPP/ORP retrieval options and limit cleanup and disposal strategies. Mitigation of waste immobilization will rely on the principle of chemical stabilization rather than macro-encapsulation or containment. See regulatory concern for the relationship to DOE orders.</p>
19	<i>Cultural/Stakeholder Basis:</i> Disposal of low-activity tank waste has the largest impact of any intentional Hanford disposal action. Stakeholders and Tribal Nations have voiced opposition to practices that will leak additional contaminants into the soil column. Deployment of the getter material as a reactive barrier will mitigate consequences of contaminants that have leaked to soils, or that may be left in tanks following retrieval.
20	<i>Environment, Safety, and Health Basis:</i> Deployment of sequestering agents will reduce the long-term risk to both human health and the environment by attenuating the migration of mobile contaminants.
21	<i>Regulatory Drivers:</i> Performance assessments are required by DOE Order 5820.2A, soon to be revised and issued as DOE Order 435.1.
22 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
23 *	<i>Material Streams:</i> Sludge, Salt, Liquid (RL-HLW-20)
24	<i>TSD System:</i> ILAW disposal facility; closed tank farms
25	<i>Major Contaminants:</i> 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	<i>Contaminated Media:</i> Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> 1/1/2002
29 *	<i>Latest Date Required:</i> 12/31/2010
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> <i>Baseline Technology/Process:</i> The current strategy for closure of Hanford double and single-shell tanks does not include the use of sequestering agents. Although use of sequestering agents has been proposed for use in support of Environmental Restoration activities on the Hanford site, the technology has not been deployed at Hanford. However, within the scientific community there is considerable interest in its potential use. The need for sequestering agent

	technology development has been identified in the Immobilized Low Activity Waste (ILAW) program logic Technology Insertion Point(s): TBD
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG, 509-372-9204, F/509-372-9447, Frederick m mann@rl.gov
35	<i>DOE End User POCs:</i> E.J. (Joe) Cruz, DOE-PRD, 509-372-2606, F/509-373-1313, E J Cruz@rl.gov P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip e lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; robert w lober@rl.gov
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**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

SITE NEED STATEMENT

General Reference Information	
1 *	<i>Need Title:</i> Contaminant Mobility Beneath Tank Farms
2 *	<i>Need Code:</i> RL-WT053-S
3 *	<p><i>Need Summary:</i> 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.</p> <p>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:</p> <ul style="list-style-type: none"> • the impact of leaks during sluicing of the tanks during cleanup • the impact of leaving the tanks (and their associated subsurface contamination) in place. <p>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.</p>
4 *	<i>Origination Date:</i> FY 2000
5 *	<i>Need Type:</i> Science Need
6	<i>Operation Office:</i> Office of River Protection (ORP)
7	<i>Geographic Site Name:</i> Hanford Site
8 *	<i>Project:</i> Closure PBS No.: RL-TW11
9 *	<p><i>National Priority:</i></p> <p><u>X</u> 1. <u>High</u> - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule.</p> <p>___ 2. <u>Medium</u> - 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).</p> <p>___ 3. <u>Low</u> - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.</p>
10 *	<i>Operations Office Priority:</i>
Problem Description Information	

11	<p><i>Operations Office Program Description:</i> 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.</p>
12	<p><i>Need/Problem Description:</i> 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.</p> <p>This science need supports the Hanford tanks technology need RL-WT061 Reactive Barriers to Contaminant Migration.</p> <p>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.</p> <p>*** Consequences of Not Filling Need: Cleanup decisions will lack technical defensibility.</p> <p>*** Program Baseline Summary (PBS) No.: TW11 Work Breakdown Structure (WBS) No.: 5.05.01.01 TIP No.:</p>
13	<p><i>Functional Performance Requirements:</i></p> <p><u>Colloidal transport mechanisms.</u> Studies are needed to evaluate the importance of colloids in enhancing the migration of radionuclides.</p> <p><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:</p> <ul style="list-style-type: none"> • 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. <p>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</p>

	<p>transuranics (Johnson and Hodges, 1997, <i>Second Symposium on Hydrogeology of Washington</i>, 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.</p> <p><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 elastic dikes). This effort should build on the work that Jacobs Engineering has already done as part of the Hanford Tanks Initiative.</p>
	<p>*** 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.</p>
14	<i>Definition of Solution:</i> .
15 *	<i>Targeted Focus Area:</i> Tanks Focus Area (TFA) and Subsurface Contaminants Focus Area (SCFA)
16	<i>Potential Benefits:</i>
17 *	<i>Potential Cost Savings:</i> \$100,000,000
18 *	<i>Potential Cost Savings Narrative:</i> 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
	<p>*** <i>Technical Basis:</i> 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.</p>
19	<i>Cultural/Stakeholder Basis:</i> 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	<i>Environment, Safety, and Health Basis:</i> 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	<i>Regulatory Drivers:</i> 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 *	<i>Milestones:</i> Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
23 *	<i>Material Streams:</i> 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	<i>TSD System:</i> 200 Area liquid discharge sites; ILAW disposal facility; SST farms; DST farms
25	<i>Major Contaminants:</i> Not applicable
26	<i>Contaminated Media:</i> Hanford vadose zone. Tank waste consisting of high molarity sodium hydroxide/sodium nitrate solution containing saturated saltcake and/or sludge.
27	<i>Volume/Size of Contaminated Media:</i> 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 *	<i>Earliest Date Required:</i> FY 2001
29 *	<i>Latest Date Required:</i> September 2008
Baseline Technology Information	
30	<i>Baseline Technology/Process:</i> Technology Insertion Point(s):
31	<i>Life-Cycle Cost Using Baseline:</i>
32	<i>Uncertainty on Baseline Life-Cycle Cost:</i>
33	<i>Completion Date Using Baseline:</i>
Points of Contact (POC)	
34	<i>Contractor End User POCs:</i> F.M. (Fred) Mann, CHG., 509-372-9204, F/509-372-9447, Frederick_m_mann@rl.gov
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36 **	<i>Other Contacts:</i> 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_Chocho@rl.gov

*ELEMENT OF A SITE NEED STATEMENT APPEARING IN IPABS-IS

**ELEMENT OF A SITE NEED STATEMENT REQUIRED BY CHG

TANKS CROSSWALK

Old FY01 ID#	FY02 ID#	NEED TITLE	Changes to FY01 Submittal	FY02 WBS No.
RL-WT001	RL-WT001	Technetium-99 Analysis in Hanford Tank Waste	Details updated; Content substantively unchanged; Title modified Priority changed from Medium to High	5.02.01.02.07.12 5.05.01.01
RL-WT004	RL-WT004	Double-Shell Tank (DST) Corrosion Monitoring	Details updated; Content substantively unchanged	5.01.03.05
RL-WT005	RL-WT005	Remote Inspection of High-Level Waste Single-Shell Tanks (SSTs)	Updated need description and schedule requirements; Recommend lowering priority from H to M	5.02.01.01.02.02
RL-WT009	RL-WT009	Representative Sampling to Support Operations and Disposal	Redefined need to reflect evolution of programmatic requirements	5.01.03.06.02 5.02.02.01
RL-WT015	RL-WT015	Standard Method for Determining Waste Form Release Rate	Details updated; Content substantively unchanged	5.04.01.03
RL-WT016	RL-WT016	Glass Monolith Surface Area	Details updated; Content substantively unchanged	5.04.01.03
RL-WT017	RL-WT017	Long-Life Waste Isolation Surface Barrier	Details updated; Content unchanged; Recommend lowering priority from H to M	5.05.01.01
RL-WT021	RL-WT021	Cleaning, Decontaminating and Upgrading Hanford Pits	Details updated; Content substantively unchanged	5.02.01.02.06.04.10 5.01.03.04.02
RL-WT022	RL-WT022	Adapting Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the Double-Shell Tanks (DSTs)	Details updated; Content substantively unchanged	5.02.02.01.01.23 5.01.03.05
RL-WT026	RL-WT026	Tank Leak Detection Systems for Underground Single-Shell Waste Storage	Updated to clarify need	5.02.01.01.02.02

Old FY01 ID#	FY02 ID#	NEED TITLE	Changes to FY01 Submittal	FY02 WBS No.
		Tanks (SSTs)		
RL-WT027	RL-WT027	Tank Leak Mitigation Systems	Updated to clarify need; Recommend raising priority from M to H	5.02.01.01.02.02
RL-WT032-S	RL-WT032	Monitoring of Key Waste Physical Properties During Retrieval and Transport	Changed from a science need to a technology need; Updated to clarify need; Recommend raising priority from L to M	5.02.02.01.02
RL-WT035-S	RL-WT035-S	Moisture Flow and Contaminant Transport in Arid Conditions	Details updated; Content substantively unchanged; Recommend lowering priority from H to M	5.04.01.03 5.05.01.01
RL-WT044-S	RL-WT044-S	Distribution of Recharge Rates	Details updated; Content substantively unchanged; Recommend lowering priority from H to M	5.04.01.03 5.05.01.01
RL-WT046-S	RL-WT046-S	Getter Materials	Details updated; Content unchanged	5.02.01.01.02.02 5.04.01.03 5.05.01.01
RL-WT053-S	RL-WT053-S	Contaminant Mobility Beneath Tank Farms	Details updated; Content unchanged; Recommend raising priority from M to H	5.05.01.01
RL-WT054-S	RL-WT054	Mixer Pump Mobilization Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)	Changed from a science need to a technology need; Details updated; Content substantively unchanged; Title modified	5.02.02.01.04
RL-WT060	RL-WT060	Hanford/SRS Waste Mixing Mobilization	Details updated; Content substantively unchanged; Title modified Priority changed from Medium to High	5.02.02.01.04
RL-WT061	RL-WT061	Reactive Barriers to Contaminant Migration	Details updated; Content substantively unchanged; Recommend lowering priority from H to M	5.05.01.01 5.04.01 5.02.01.01.02.02
RL-WT062	RL-WT062	Variable Suction Level Transfer Pump	Details updated; Content unchanged	5.02.02.01.04

Old FY01 ID#	FY02 ID#	NEED TITLE	Changes to FY01 Submittal	FY02 WBS No.
RL-WT063	RL-WT063	Hanford SST Saltcake Dissolution Retrieval	Need/problem descriptions updated	5.02.01.01.01.01
RL-WT064	----	Hanford Past Practice Sluicing Improvements	Deleted; Lessons have been learned from C-106 retrieval and focus is now on alternate technologies	---
RL-WT066	RL-WT066	Compositional Dependence of the Long-Term Performance of Glass as a Low-Activity Waste Form	Details updated; Content substantively unchanged; Recommend lowering priority from H to M	5.04.01.03
RL-WT067	RL-WT067	Improved Double Shell Tank (DST) Integrity Nondestructive Examination (NDE)Measurement Tools	Details updated; Content substantively unchanged; Functional performance requirements refined	5.01.03.05
RL-WT068	RL-WT068	Radionuclide Source Term from Tank Residuals	Need/problem descriptions updated; Recommend lowering priority from H to M	5.02.01.01.01.01
RL-WT069	RL-WT069	Value of Information Decision Analysis for Tank Farm Closure	Rewritten to refine description and performance requirements	5.02.01.01.02.02
RL-WT072	RL-WT072	Use of Handheld Technology to Automate Operator Data Sheets for Tank Farm Operations: Surveillance Automation for Tank Farms	Rewritten to refine description and performance requirements; Title modified	5.01.03..01
RL-WT076-S	----	Plutonium Interaction with Silicates	Deleted; Technology need RL-WT068 incorporates this need	---
RL-WT077	----	Improvements to Salt Well Pumping	Deleted; FY01 workshop recommendations will be implemented in FY02; no further need exists for FY03	5.01.04.01
RL-WT078-S	----	Plutonium Segregation and Association in HLW	Deleted;Criticality concerns have been resolved	---
RL-WT079-S	RL-WT079-S	Double Shell Tanks (DST) Corrosion Chemistry	Details updated; Content substantively unchanged	5.01.03.05

Old FY01 ID#	FY02 ID#	NEED TITLE	Changes to FY01 Submittal	FY02 WBS No.
RL-WT080	RL-WT080	Advanced/Improved Vitrification	Transferred to WTPC; Details updated; Content substantively unchanged	
--- WT083 - not submitted in FY01	----	Rapid Polychlorinated Biphenyl (PCB) Measurement System	Submitted in FY02 as RL-WT117	5.01.01.02 5.01.03.06.01.04
RL-WT084	RL-WT084	Extension of Glass Properties Model to LAW and Phase II HLW Glass Composition Ranges	Transferred from WTPC to BOM; Details updated	
RL-WT086	RL-WT086	Anti-foaming Agents for Evaporation of Alkaline Wastes	Transferred to WTPC; Details updated; Content substantively unchanged	
RL-WT087	----	Assessment of Effects to HLW Glass Production Using Crystalline Silicotitanate (CST) to Separate Cesium from Alkaline Waste Solutions	Deleted; RL-WT092; work on CST has been completed	
RL-WT088	RL-WT088	Advanced Approaches for Reducing Waste Volume Stored in DSTs	Details updated; Content substantively unchanged	5.02.02
RL-WT089	RL-WT089	Alternate Retrieval Methods from Potentially Leaking Single-Shell Tanks (SSTs)	Details updated; Content unchanged	5.02.01.01.01.01 5.02.01.01.03.02
RL-WT090	RL-WT090	Chemical and Physical Behavior of Sludge Wastes	Details updated; Content substantively unchanged	5.02.02.01.02.01
RL-WT091	RL-WT091	Chemical and Physical Behavior of Saltcake Wastes	Details updated; Content unchanged	5.02.02.01.02.01
RL-WT092	RL-WT092	Improved Separation Agents and Processes to Remove Cesium from Supernatant Solutions	Transferred to WTPC; Details updated	
RL-WT093	RL-WT093	Filtration Optimization and Process Enhancement	Transferred to WTPC; Details updated; Content substantively unchanged	
RL-WT094	----	Understanding and Controlling Post-filtration	Deleted; ongoing studies have addressed the need	

Old FY01 ID#	FY02 ID#	NEED TITLE	Changes to FY01 Submittal	FY02 WBS No.
		Precipitation		
RL-WT096	----	Cold Test/Mockup Facility	Deleted Technology need no longer exists as contract is placed.	5.02.01.01.04
RL-WT098	RL-WT098	Erosion Testing	Transferred from WTPC to BOM; Details updated; content substantively unchanged	
RL-WT099-S	----	Rapid Analysis of Vitrification Feeds	Transferred from WTPC to BOM; Deleted; content incorporated into new technology need RL-WT122	
RL-WT100	RL-WT100	HLW/LAW Melter Operation	Transferred from WTPC to BOM; Details updated	
RL-WT101	RL-WT101	Sulfate Mitigation for Hanford Tank Low Activity Waste (LAW) Vitrification	Transferred to WTPC; Details updated; Content substantively unchanged	
RL-WT102	RL-WT102	Advanced Characterization Tools for Contaminants of Concern	Need/problem descriptions expanded; Recommend lowering priority from H to M	5.05.01.01
RL-WT103	RL-WT103	Separable Organic Phase Destruction, Removal, and Monitoring In Tank Waste	Details updated; Content substantively unchanged Recommend lowering priority from H to M	5.01.04.02.04.01.01. 01 5.01.04.02.04.04
---	RL-WT104	Cleanable HEPA filter	New need	5.01.03.02
---	RL-WT105	Coalescer for Tank Waste in Pits and Airborne Contamination	New need	5.01.03.04.02
---	RL-WT106	Double Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools	New need	5.01.03.05
---	RL-WT107	Grab Sampling Dose Reduction	New need	5.01.03.06.06.02
---	RL-WT108	In-tank Camera and Lighting	New need	5.01.03.04
---	RL-WT109	Radiation Survey	New need	5.01.03.01
---	RL-WT110	Remote Jumper Gasket Replacement	New need	5.01.03.04.02

Old FY01 ID#	FY02 ID#	NEED TITLE	Changes to FY01 Submittal	FY02 WBS No.
---	RL-WT111	Remote Tank Wall Repair	New need	5.01.03.05
---	RL-WT112	Chemical Dissolution of Water Insoluble Wastes from Single-Shell Tanks (SSTs)	New need	5.02.01.01.01.01
---	RL-WT113	Selective Species Removal	New need	5.02.01.01.01.01
---	RL-WT114	Tank Farm Weather Enclosure	New need	5.01.02.04 5.01.03.04 5.02.01.01.32 5.02.02.02.0 (W-211) 5.02.02.03.01 (W-314)
---	RL-WT115	Technology to Support Post-Retrieval Evaluation of Single Shell Tanks (SSTs) During Retrieval	New need	5.02.01.01.01.01
---	RL-WT116	Toxic Gas Control during Waste Retrieval	New need	5.02.01.01.01.01
---	RL-WT117	Rapid Polychlorinated Biphenyl (PCB) Measurement System	New need	5.01.01.02 5.01.03.06.01.04

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